ELECTRICAL ENGINEERING

SEPTEMBER 1943

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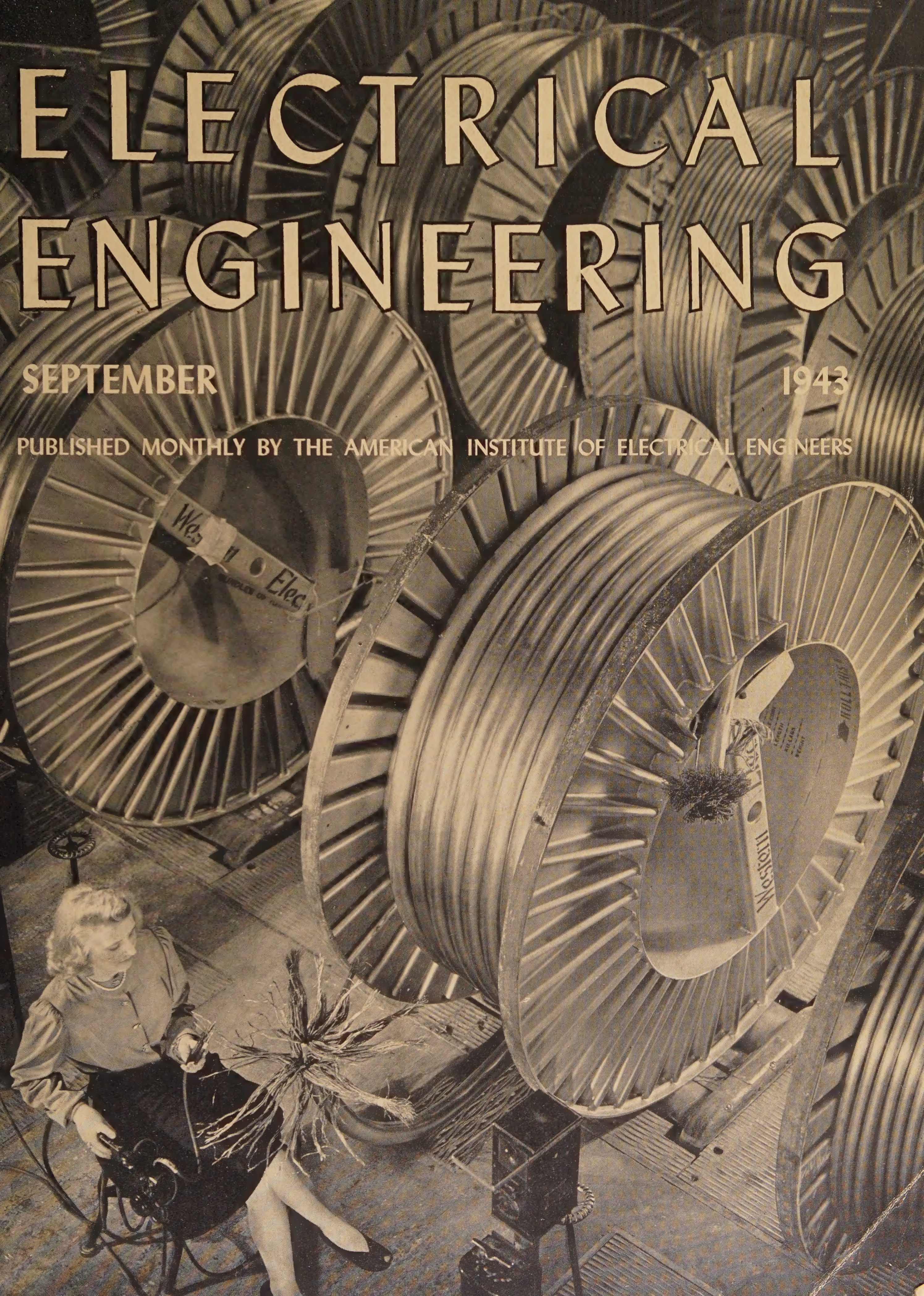

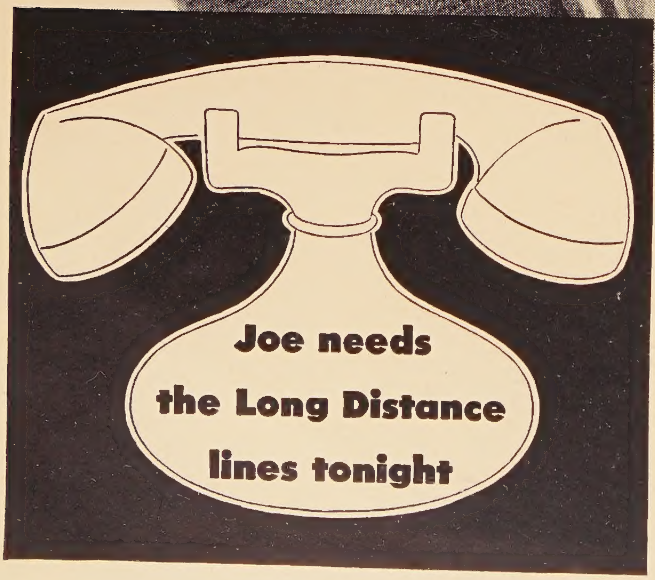

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SEPTEMBER
1943

The Cover: Although one of the by-products of the war has been the increasing influx of women into industry, women workers are no novelty in the electrical field where they have been employed for many years in some of the more delicate operations. The girl on the cover is conducting an inspection test of telephone toll cable

—Western Electric Photo by Holmes I. Mettee

TRANSACTIONS SECTION

(*Follows EE page 428; a preprint of pages 563–610 of the 1943 volume*)

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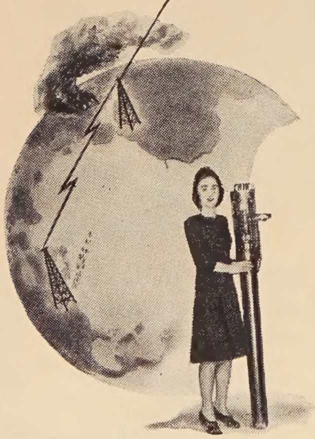

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* * *

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* * *

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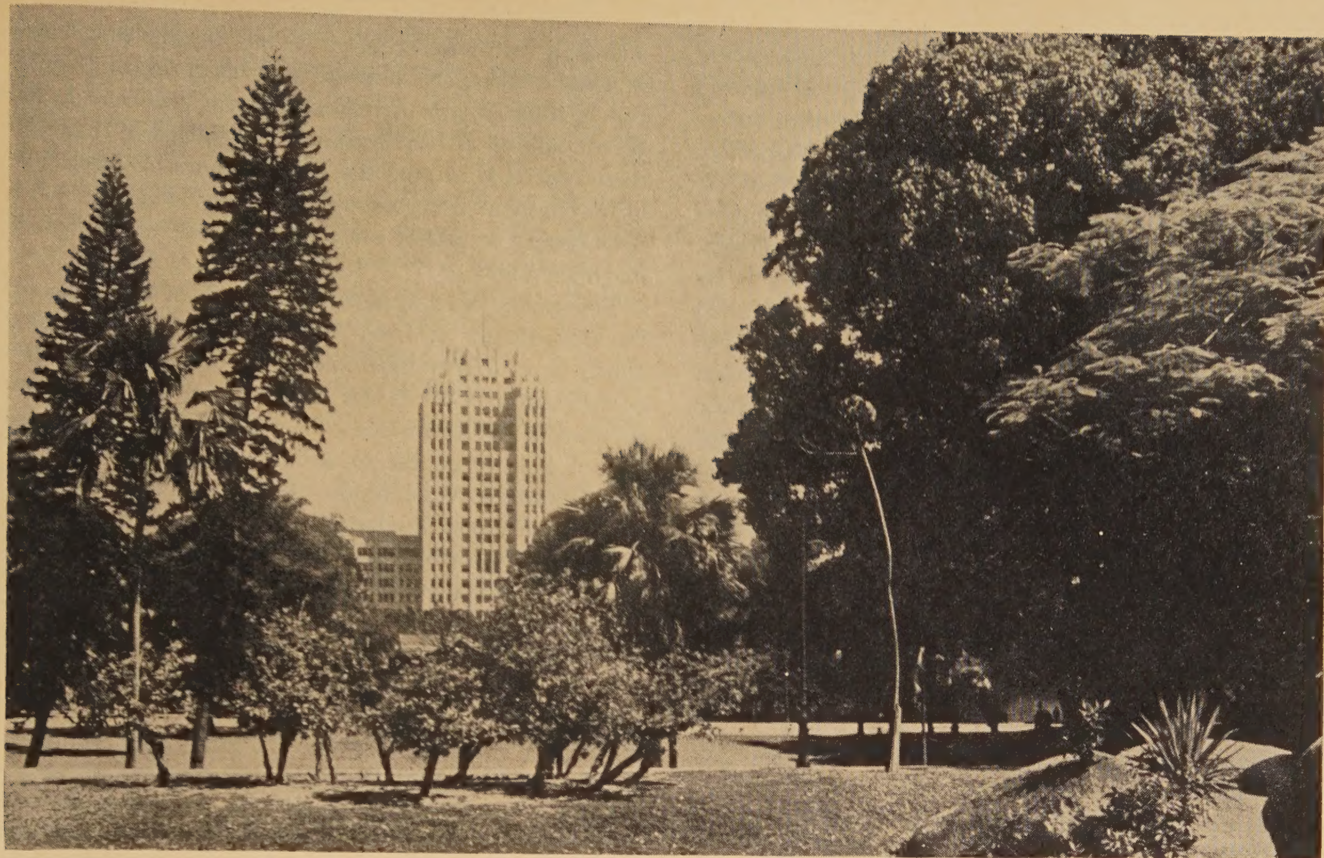


Photo courtesy General Electric Company

View of Praca da Republica, Rio de Janeiro, with war department building in background

Inter-American Affairs of Interest to the Engineer

JULIAN L. SCHLEY

The engineer has an important stake in the progress of inter-American relations and an outstanding part to play in translating inter-Americanism into reality. The Office of the Coordinator of Inter-American Affairs and the Inter-American Development Commission both work to promote better co-operation and collaboration among the Americas.

THE SUBJECT of inter-American affairs, both as a war measure and as a permanent and growing relationship among great republics in this hemisphere, is a matter that grows in one's consciousness and interest; the more one thinks about it, the more he learns about it. The great wonder is that two decades ago we did not ourselves become conscious of that great need and what it would mean in the future to us in case of war and in time of peace, ultimately, if not immediately. The war and the development of inter-American co-operation have progressed to a point which makes this discussion timely. It is evident from the news that the tide of war is turning toward victory for the United Nations. The Americas united are playing a great role in the upbuilding of the growing strength of the United Nations. Working together, as they are now doing effectively, the American republics have become a powerful force in world affairs. I believe the Americas will continue to be the basis for postwar development of hemisphere resources, just as they are the basis now for wartime development.

Certainly no single technical group will have more to

Essential substance of an address at the AIEE national technical meeting, Cleveland, Ohio, June 21–25, 1943.

Major General Julian L. Schley is director of transportation, Office of the Coordinator of Inter-American Affairs, Washington, D. C. He was formerly chief of the Engineers Corps of the United States Army.

do with the economic development of the hemisphere than electrical engineers. The power age, as we well know, was making rapid headway in many of the other American republics prior to Pearl Harbor. Electricity was spreading its manifold benefits in improving the national economy and in making life better in neighboring republics, just as it has done here in North America. Still the power age in Latin America as a whole is far from the advanced development we know in the United States. But these countries have an urge to learn and to move ahead. Once the way is open again for resumption of normal industrial development, including electric development, I am sure we shall see long strides toward the utilization of the vast power potentials of Latin America. In this development, inter-American co-operation will provide a firm foundation for the linking of North American technical skill with the resources and industrial opportunities of our neighbors to the south.

In its broadest objectives, inter-American co-operation aims at making life happier and better for the average American. And that means the average American in the other Americas as well as in the United States. It is up to you engineers to help translate this worthy aim of inter-Americanism into reality. The material reality of higher living standards is represented by power plants, by transmission lines, by electrified industrial plants, by radios, washing machines, refrigerators, and the hundreds of other mechanical contrivances which have been fashioned from the miracles of electricity. These bring better living in a very real sense. And well do our neighbors to the south understand this. Their support of inter-American unity makes manifest their desire to join heartily in the advancement of hemisphere aims and the fuller use of hemisphere resources.

Today this co-operation is focused on the strengthening of hemisphere defenses and the mobilization of hemisphere resources in support of the United Nations. The Axis menace of aggression must be eliminated from the world before the Americas again can feel secure and free to pursue their long-range aims of building in this hemisphere a new world of happier living for the average citizen. Inter-American co-operation embraces work for the expansion of production of strategic minerals and at the same time, a large-scale development program to replace vital supplies formerly imported from the Far East and from other sources outside the hemisphere. This co-operation has brought new machinery for joint action among the Americas. It involves joint action in the construction of highways, airports, hospitals, and other facilities to meet immediate war needs. It includes co-operation in the removal of Axis influences from hemisphere airlines and from key industries.

Inter-American co-operation rests on the strong foundations of the good-neighbor policy. It is now ten years since President Roosevelt stated this policy at the start of his administration. Meanwhile, that policy has become deeply rooted in national thinking and acting in the United States. It has become established as a national policy, surpassing partisan debate. Progress in inter-American relations during this decade has been notable. It has been fortunate indeed in these last three crucial years that the United States has been able to strengthen immeasurably friendly relations with neighboring republics on the solid base of the good-neighbor policy.

This policy is expressed in the work of the Office of the Coordinator of Inter-American Affairs, an agency which aims to crystallize and bring into full power the co-ordination of all things leading to a proper understanding of Latin America. The office began in the summer of 1940 when the Coordinator, Nelson A. Rockefeller, arrived in Washington. France had fallen. Alone across the channel, England faced the Nazi war machine. Many on this side of the Atlantic were awakening to the grave peril of the Axis menace to the freedom of the Americas. In those dark days one bright beacon of hope was the growing mutual confidence and understanding among the Americas, resulting in steadily improving inter-American relations.

It was a somber period for the American republics. Latin America had lost the European continental market which had taken part or most of many of its major exports. On this side of the Atlantic, only United States industry had the capacity to turn out war machines to match and surpass the war machines of the Axis. For years, Axis agents in Latin America had been pursuing political, economic, and psychological warfare. This preliminary strategy, as we know so well now, usually is the forerunner of Axis military action. That pattern of Axis warfare has been re-enacted over and over in Europe and Asia. The Americas, with their rich and varied resources, were marked for conquest. The Axis strategists, in those somber days after Dunkirk, apparently were sure in their own minds that the Americas would never awake in time.

Today, we know that the Americas did awake. And how thoroughly and alertly they have awakened may be seen in the tremendous production of war equipment from these arsenals of democracy around the Great Lakes. The smoke of your factories, the clang of your forges, the hum of your assembly lines convincingly have answered the Axis propaganda line that democracy was outmoded, that it was too slow to save itself.

In those grim days of 1940 when the Office of the Coordinator of Inter-American Affairs was born, when we as a people were emerging from complacent thought that war might never reach these shores, there was much work to be done in the furtherance of inter-American co-operation. There was, for instance, the question of what the Americas would do to offset the loss of foreign markets. The Latin American republics, perhaps more than any other group of nations, had been peculiarly dependent upon foreign trade. They produced in the main staple products for export. With the proceeds of

these exports they purchased abroad most of their manufactured goods, their capital equipment, their shipping and insurance, and other services. The disruption of foreign trade, therefore, was a terrific blow to the economics of the Americas.

Realizing this, the United States took measures to help the Americas through this period. The Export-Import Bank of Washington placed at the disposal of the other Americas large credits to help stabilize their exchanges. The Coordinator's organization went to work to stimulate United States purchases in the other Americas, to improve commercial relations in every way possible, to hasten development of complementary industries.

Our armament program greatly facilitated these efforts to encourage inter-American trade. War production opened a huge market in this country for metals, wool, forest products, and other exports the other Americas previously had sold wholly or partly outside the hemisphere. Our imports from the other Americas in 1941 rose to approximately $1,000,000,000, nearly double the prewar level.

At the same time, the Coordinator's office initiated extensive work for the improvement of inter-American understanding. This work now covers a wide range in educational and informational fields. It includes the exchange of public authorities, writers, newspapermen, technicians, scientists, and outstanding personages in other fields, who contribute toward the development of the consciousness in the Americas of their common interests. As an example, a well-known Brazilian hydraulic engineer was recently invited to spend six months at the Vicksburg laboratory of the Engineers' Department of the United States Government at the department's request. This matter the War Department was extremely pleased to negotiate, not only because it will help Brazil to go forward in its water developments, but because it is a gesture of great value to us.

Such work has been responsible in large measure for the continued growth of mutual trust and confidence between the United States and the other Americas in the fateful years since the fall of France.

This work also includes the bringing of many young people to the United States from the other Americas for study and technical training. One of the most extensive of these training programs is in industry. Many young men from the other American republics have been brought to the United States to work and to learn at first hand in our factories, mills, business offices, agricultural establishments. Many young men also have been brought to the United States for aviation training.

Our colleges also are having difficult times now with the great load being thrown on them, different from the ones they are used to, and the training programs for cadets and arrangements for other special classes they are unaccustomed to. Anything that can be done through the AIEE to encourage the colleges to show a greater interest in these students we are able to bring up from Latin America to take special courses will be a help. These young men will return to their native countries where they will be among the leaders of the future. They represent a new generation of inter-American leaders who will help shape the further growth of inter-Americanism.

Likewise in this category are new technical schools and agricultural experiment stations which the United States, through the Office of Coordinator of Inter-American Affairs, has aided. These include a meteorological school in Medellin, Colombia; a business school in Bogota; a proposed engineering school at Caracas, Venezuela; and the newly established Inter-American Institute of Agricultural Sciences in Costa Rica. The meteorological school is particularly valuable from the air transportation point of view, since air movement becomes vastly safer when the weather conditions are fully known, and the absence of meteorological stations and perhaps the lack of appreciation of their importance are a great bar to safe flying. What these projects, and others like them, mean in the long run for the improvement of inter-American understanding and for the advance of technology you engineers well appreciate. These institutions are spear heads of technical progress. They will aid in the long-range improvement of inter-American living standards through the use of modern machines and production methods. The other Americas have the natural resources. What they need principally are capital, technical knowledge, markets, and freedom to pursue their aspirations. For help, they naturally look to the good neighbor in the north, just as we look to the good neighbors of the south for help in obtaining the vital materials we need to increase war production and to replace supply losses outside the hemisphere. This mutual aid emphasizes the natural foundation for co-operation among the Americas.

The work of the Coordinator's office, along with the work of other government agencies, underwent sharp readjustment to war needs after Pearl Harbor. At the Rio de Janeiro conference in January 1942 the American republics adopted a historic program to strengthen hemisphere defenses and to mobilize hemisphere resources. This program has been translated into action in the form of hundreds of projects for development of strategic materials, improvement of communications, large-scale health and sanitation measures, and expansion of food supplies. These projects are designed to meet immediate wartime needs. Yet they also create facilities for better national economy and higher living standards in the long run. The development of new industries; the construction of power plants and transmission lines, of hospitals, health centers, sanitation works; the extension of highways; the building of airports, warehouses and other durable works will remain after the war to become lasting additions to the productive and living facilities of neighboring republics.

Normal development of industry for civilian consumption since Pearl Harbor has been retarded or postponed in the other Americas, as in this country. The shipping shortage and the concentration of United States industry upon war work rules out today development of industries for consumer markets in neighboring republics, where this development depends upon the United States for machinery and materials. Still, much development work moves forward out of urgent wartime necessity. One example is Brazil's big steel plant at Volta Redonda, scheduled for completion in 1944. The Brazilian steel plant was undertaken before Pearl Harbor. It is proceeding with the aid of equipment and materials from the United States, partly out of recognition that Brazil must develop her vast resources of mineral, agriculture, and forest products to help supply United Nations needs. Brazil needs railroads to tap her immense hinterland, where minerals and forest products lie undeveloped. Once this steel plant has been completed, it will also serve for the long-range work of advancing production and living standards in Brazil. In this sense, the inter-American story is much the same as the postwar gains we stand to reap from the utilization of our own war-expanded capacity to produce steel, light metals, tools, airplanes, chemicals, and other industrial essentials.

Another example of strategic industrial projects which must go forward is the rehabilitation of key Mexican railroads. This project has been undertaken by Mexico in co-operation with the United States, through the Office of the Coordinator of Inter-American Affairs, and is being carried out by the Mexican Railway Mission, headed by Oliver M. Stevens, formerly of the Missouri Pacific Railway. The Mexican railroads are of increasing importance, as the results of a shift in traffic to overland routes and the expansion in production of vital materials in Mexico and Central America for United States war industry. Any movement by rail from Central America to Texas is of tremendous advantage, now that shipping is dangerous by sea. The wartime improvement in Mexico's railroads, like Brazil's steel plant, doubtless will make an enduring contribution to the welfare of our neighbor across the Rio Grande.

Still other examples are the extension of commercial airlines, which are carrying much of the passenger load and even some of the freight load formerly handled by ocean shipping; the closing gaps in the inter-American highway in Central America, which we hope will be finished before long as far as Panama; the construction of many new hospitals, health centers, and sanitation works as part of the inter-American health and sanitation program. Malaria and other diseases are among the first problems which must be considered in any development of economic resources in the Amazon Basin, in Central America, and in other hemisphere areas co-operating in the wartime development work. Food for the workers and their families also is of prime concern in the expansion of production of rubber, fibers, minerals, and similar strategic materials. For instance, in the great Amazon Basin there is plenty of water but very little food, and almost all the rubber workers have to be fed by importation of food into that vast area. These twin human necessities—health and food—have been recognized in the basic-economy program of the Office of the Coordinator of Inter-American Affairs. We have something like 20 floating dispensaries on the Amazon Basin, serving the Rubber Development Corporation's workers.

This brief summary leads to an appraisal of the situation today. Where is inter-American co-operation heading, particularly in the economic field? The currents are deep and well defined. They flow strongly along the course of closer inter-American co-operation, and this includes co-operation in the development of trade and industries.

What is being done in this direction is more than temporary—it is for all time, we hope, and will continue at an increasing pace. We hope also that it is being conducted on such a basis that it will become more and more self-perpetuating, and that ultimately we will be able to carry on without government aid.

The other Americas are accumulating substantial backlogs of purchasing power as a result of our heavy buying of strategic materials and their inability to spend these balances immediately on goods from the United States. In other words, our purchases of raw materials have now reached such a large sum, that their inability, in reverse, to buy from us, because of our war restrictions on strategic materials, has placed in their hands a tremendous amount of money which needs use. These are nest eggs for use in the postwar period when our war-expanded industry will be better equipped than before the war to supply many of the things the other Americas want, including steel, chemicals tools, machinery. Inflationary forces in the other Americas, bringing rising living costs, present a serious problem, just as the rising trend of living costs does in the United States. The solution of this problem, too, requires inter-American co-operation.

So far as one may rationalize on the basis of the visible factors, one reaches the conclusion that inter-American trade will remain at a high level for years to come. Many readjustments will be necessary after the war, just as many readjustments had to be made to war conditions. Thus far, the Americas have made these adjustments fairly successfully. They have learned to work together in mutual understanding. What they have achieved already prompts optimism in judging their capacity to make further adjustments as problems arise.

As for success in doing private business with Latin America, there is no magic formula. It is a matter of hard work, of tact, of intelligent understanding, of sincere effort to see the other man's viewpoint and to assure to him his share of the bargain. Those who

have had broad experience in business in Latin America see virtue in these suggestions:

1. Successful business in the other Americas should be on a development and not on an exploitation basis. Those who expect to make a quick and fat profit from Latin America, who are not prepared to stand a year or two of development expense, might do well to hesitate on future ventures.

2. The other Americas are not newly discovered markets. On the contrary, many large United States organizations have been doing business in Latin America for years. They have learned that fair dealings bring recompense, that a good-neighbor policy is just as fruitful in business as it is in diplomacy.

3. There are risks in doing business in Latin America just as there are risks in doing business in the United States. One source of risk is the failure of many people to realize that each of the other Americas is a separate national entity with its own special characteristics. Operations must be conducted under the laws and customs of the individual country. An organization planning to do business in the other Americas would do well to study the local conditions, customs, and laws before making extensive commitments.

Moreover, businessmen should remember that new mechanisms have been created for the encouragement of inter-American trade and industry. The Inter-American Development Commission and the development commission established in each of the American republics (21 in all) are among these new mechanisms.

The Inter-American Development Commission is an undertaking created by conventions of the 21 American nations in Rio de Janeiro, Panama, and other places. It is entirely independent of the war, for it was created considerably before the war and will last long after it. It is at the disposal of all businesses in the United States, and of every organization in Latin America and of their governments.

Mr. Rockefeller, the coordinator of Inter-American affairs, is also president of the Inter-American Development Commission.

This Commission has in each of these Latin American countries a subdivision or a national commission, composed of the nationals of that country, all prominent men who serve the main commission in their own country and are prepared to do all possible to increase its economic well being. The development commissions provide channels for collaboration between private interests and governments in the furtherance of new industries and trade. Their work should become of greater importance after the war when it will be practical to resume industrial development along more normal lines than is now possible.

Through such channels as the inter-American development commissions, government and business together assume jointly the widest possible responsibility for new enterprise, in contrast with fly-by-night exploitation. They are guided by local customs and laws and the broad objectives of inter-American co-operation.

The inter-American development commissions are not to be confused with government organizations. That group in Brazil, that group in Argentine, that group in Chile, which is a local commission of this IDC, has no relationship with its government, but it is a subcommission of the commission, created by the 21 nations in congress assembled.

As for the prospects of electrical development in Latin America, we are familiar with the estimates of the tremendous hydroelectric potentialities in such countries as Brazil and Chile. The Latin American countries are well aware of their latent power resources and of the possibilities of harnessing this power to the production of aluminum, to mining and manufacturing.

Lack of coal, now keenly felt, increases their incentive to develop electrical power. For wider use of these power resources, they need capital and equipment, as well as expanding internal markets for the power once it is developed. In many areas of high power potential, rainfall is sufficiently abundant to provide a good flow of water. There also are promising possibilities for the construction of water storage facilities and for projects of combined water uses.

With the development of these resources, one might logically expect to see interconnection of power systems. Postwar developments in Latin America may see a trend toward large base plants, supplanting in many localities small ones independently serving restricted territory.

The engineer has an outstanding part to play in convincing our neighbors that inter-American development will be a matter of mutual benefit to the countries participating. The AIEE members in Latin America can be of tremendous service to you in an understanding of the situation, of the possibilities in Latin America, because they are men who live there, they are men who know the conditions, they are men who have the reaction of what we do in this country, whether favorably or unfavorably. They know how business is conducted in those countries. They know the great importance of standards in production.

This brings me to one final observation: the electrical engineer has a very important stake in the progress of inter-American relations. The Americas are learning to work together for joint solution of common problems in an atmosphere of growing mutual trust. The many projects they are carrying on jointly today demonstrate this ability of the Americas to work together. The inter-American system of co-operation offers to a war-torn world a road to enduring peace and stability. This principle likewise offers a guiding principle for businessmen in search of a sound basis for the development of inter-American trade and new hemisphere industries. The inter-American way of co-operation and peace has been proved sound beyond debate. The methods of the Axis military powers only emphasize the merits of the inter-American system. Whether it is in foreign relations, inter-American trade, or engineering enterprise, the co-operative principle in the long run will yield the best results.

Inter-American Co-operation in the Development of Standards

R. E. ZIMMERMAN

Interest in international standardization is increasing rapidly in Latin America—to a considerable extent through the efforts of the American Standards Association which has sought ways and means of supplying more adequate American representation and co-operation in the development of standards. The program for the future includes exchange of technical data among the various American republics and development of inter-American standards to the advantage of all the Americas.

DEALINGS among and between peoples are facilitated when there is a common understanding among the parties involved, and, if the dealings relate to things or articles of commerce, then so much the better if the standards pertaining to their manufacture, performance, and acceptance are mutually understood and agreed upon.

International standardization is a matter which can be realized only in part, even where descriptive standards are applicable. National differences in aspirations, language, natural resources, physical equipment, and long-established customs and methods operate to mark off certain areas as favorable, others as unfavorable, for the spread of international standards. The International Electrotechnical Commission has accomplished much in bringing about practically world-wide uniformity in units, measures, and nomenclature. Such agreement upon the use of a common set of scientific designations has facilitated greatly the interchange of technical information. Less marked have been the results secured thus far by the International Standards Association, in which this country, through the American Standards Association, is represented along with 21 others. Although its world-wide activities necessarily have been interrupted for the period of the war, the international association has made substantial progress on a selected group of projects. In general, to whatever extent the international acceptance of practically identical or equivalent standards has been found feasible, in like measure have benefits been conferred upon science and industry and upon the peoples they serve.

Inter-American co-operation in the adoption of standards, from our standpoint, presents some conditions which are different from those involved in collaborating with the highly industrialized nations of Europe. Organized standardization in the other American republics is of relatively recent origin, as compared with the set patterns prevailing elsewhere. Moreover, in quite a number of the Central and South American nations, standards and specifications are of preponderating interest as applied to imports, rather than to domestic production. In certain countries, however, the consideration of domestic production is coming more and more into prominence, and the pace is rapidly accelerating. So likewise is the awareness of the value of standards, as applied to all classes of products.

Hemispheric security and solidarity have a special significance for all of the American nations during a period of global war. Mutual help in overcoming a common enemy calls for pooling resources and working together with the highest possible degree of understanding. Minds must meet and things must fit. Strategic materials are needed now and will be needed later, regardless of name. In numerous material ways interchangeability enters the picture, and standardization is indicated.

Good-neighbor policy stretches over periods of both war and peace and provides for the exchange of benefits in all fields of endeavor. It is our hope that what we have learned in the development and use of standards here in the United States may qualify as one of the items of benefit in the series of exchanges which will mark our living and working together with these neighbor republics.

Exports to the Americas and imports from them are bound to have an important relationship to standards and standardization, if commercial intercourse between and among the republics is to be facilitated. In the United States, producers of goods for export are deeply interested in markets throughout this hemisphere, as well as elsewhere. They have something to offer, many things needed in Central and South America, and expect acceptance only on the basis of price, quality, and service. On the other hand, it would be strange if the other American republics did not wish to offer their products in the markets of the United States.

In furtherance of both of these aims, it is to the interest of the parties concerned that the standards adopted for application to the articles of commerce be appropriate in every respect. One of the matters over

Essential substance of an address at the AIEE national technical meeting, Cleveland, Ohio, June 21–25, 1943.

R. E. Zimmerman is vice-president in charge of research and technology of the United States Steel Corporation, New York, N. Y., and is currently president of the American Standards Association.

which we in the United States are solicitous is that the standards which are being formulated by the countries actively interested in the movement toward standardization be not drawn in such a way as to exclude our goods or to place them at an arbitrary disadvantage with the products of other exporters. Many of us in the United States do not realize the extent to which foreign competitive influences have been at work in the American republics for the purpose of bending proposed standards in that very direction. Because of our failure to apply adequate measures of co-operation during the periods when specifications and standards were being formed and technologists of other nations were hard at work on the scene, there is already a considerable handicap to be overcome. The present world situation affords us an opportunity, if we will embrace it properly, to make up in co-operation what we have omitted over a period of years.

It must be said, in justice, that the condition described as pertaining to the American republics, although characterized by inadequate measures, has not been one of utter neglect. From time to time various governmental agencies, such as the Bureau of Foreign and Domestic Commerce and the National Bureau of Standards have lent a helping hand with respect to specifications. Some years ago a number of the standards of the American Society for Testing Materials were published in Spanish and Portuguese and distributed. More recently that society's standards on refractories were translated into Spanish; the Argentine government oil fields published the ASTM petroleum standards, and the Argentine Cement Institute translated and distributed the standard specifications for concrete.

As early as 1924, on the initiative of several of the South American countries, a Pan-American conference on standardization was held at Lima, Peru, in connection with a scientific conference under the auspices of the Pan-American Union. Again, two years later, a second such conference was held in Washington. Considerable work was done, but practical results were meager.

During 1941 the division of engineering and industrial research of the National Research Council conducted a tour of industrialists through Latin America in the interest of increased co-operation. The Inter-American Safety Council, founded in 1938, co-operates with the accident-prevention associations in some 20 American republics by supplying information on safety codes and methods. Its membership comprises more than 1,000 industrial units employing in the aggregate about 1,000,000 workmen. In this field of co-operation desirable progress is being made.

Collateral contacts of value are maintained throughout the Americas by our five engineering societies through resident members in various countries, by the exchange of bulletins, and by various services performed. Memberships that now exist in the other Americas are of the utmost importance in any of the work of collaboration that we can hope to carry on. These societies, for example, have a Joint Committee on Inter-American Relations which is planning to print, in Spanish and Portuguese, a digest embracing a large number of papers which should be of interest to engineers. Again, the AIEE and the American Standards Association have had a joint committee concerned with certain special phases of inter-American standardization. The work of that committee is done, and it is not functioning now, but the work that was stimulated by the collaboration is being carried on.

Due mention must be made of the valient services performed, over a period of years, by the American Chamber of Commerce in Buenos Aires. In the absence of any other agency, members of this body have kept in close contact with the standardizing institute of the Argentine, assisting in every way possible with the formulation of standards and carrying the American point of view into the proceedings. This chamber in Buenos Aires has likewise played a most important role in effecting plans for organized full-time American representation in the standardization movement in South America.

As mentioned heretofore, interest in standards is increasing rapidly in many of the American republics. Among the more prominent standardizing bodies already set up and functioning are the following:

Mexico: On January 1, 1943, the Direccion General de Normas Nacionales, or Department of National Standards, was organized to replace the former Department of Weights and Measures. The present organization has quite a wide program for standardization. It is governmentally sponsored but is in quite close touch with the work that is going on in the United States, and, as an aid to the operations in Mexico City, an advisory committee, with representatives from five American interests located in Mexico, is proceeding to help the Department of National Standards.

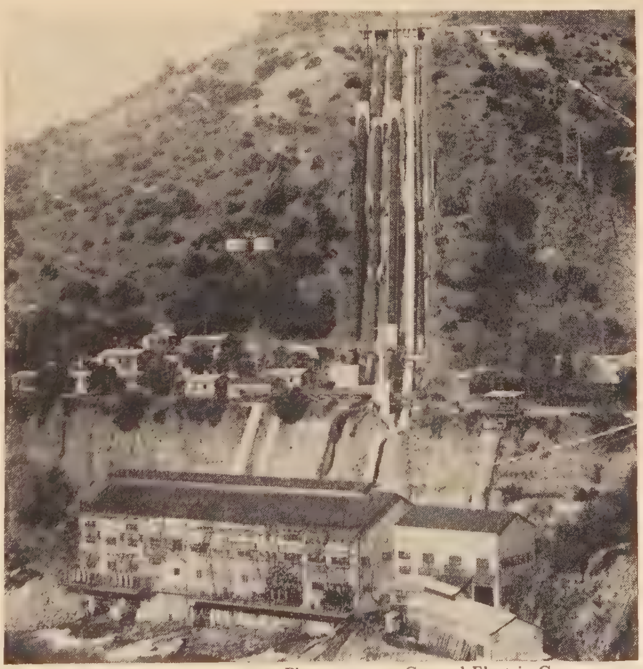


Photo courtesy General Electric Company

Coya hydroelectric plant, Chile

Argentina: This was the first Latin American country to establish a national standardization body. It is called Instituto Argentino de Racionalizacion de Materiales, and it functions much like the American Standards Association.

Brazil: Here the Associacao Brasileira de Normas Tecnicas, similar in constitution to the ASA, takes care of the work of standardization. Another institution, the Instituto de Pesquisas Tecnologicas de Sao Paulo, performs some of the laboratory functions of a national bureau of standards. It is our understanding that these two bodies work in close collaboration, but the recently organized and functioning Association of Standards is taking care particularly of the standardization work in Brazil.

Chile: At present there is a government department which issues mandatory standards for electrical equipment. In November 1942 the first Chilean Engineering Congress recommended the establishment of a designated standardization institute. The movement is well supported, and the expectation is that an institute will soon be organized and functioning in Chile.

Uruguay: The Instituto Uruguayo de Normas Tecnicas is a recently organized body but is busily engaged with a large number of standards.

In other countries not listed here, standardization is being handled by different agencies whose operations are being followed with interest.

The American Standards Association, for more than five years past, sought ways and means of supplying more nearly adequate American representation and co-operative effort in matters pertaining to standards in South America.

When I use the word, "American," I mean all of the Americas. Naturally, we are interested in carrying the ideas of the standardizing bodies of the United States as far as we can, but we realize that there must be a meeting of minds, and that this is a co-operative effort, so that the American point of view means the point of view of all the Americas.

Through correspondence and contacts of long standing this need for American representation and co-operation was clearly recognized, and the urgency of the situation was emphasized repeatedly by members of the American Chamber of Commerce at Buenos Aires. Similar views had been expressed by committees of the American engineering and technical societies, by trade associations, and by members of industry. During the summer of 1942 a succession of events brought the awaited opportunity to crystallize plans and to take definite measures toward enlarged inter-American collaboration.

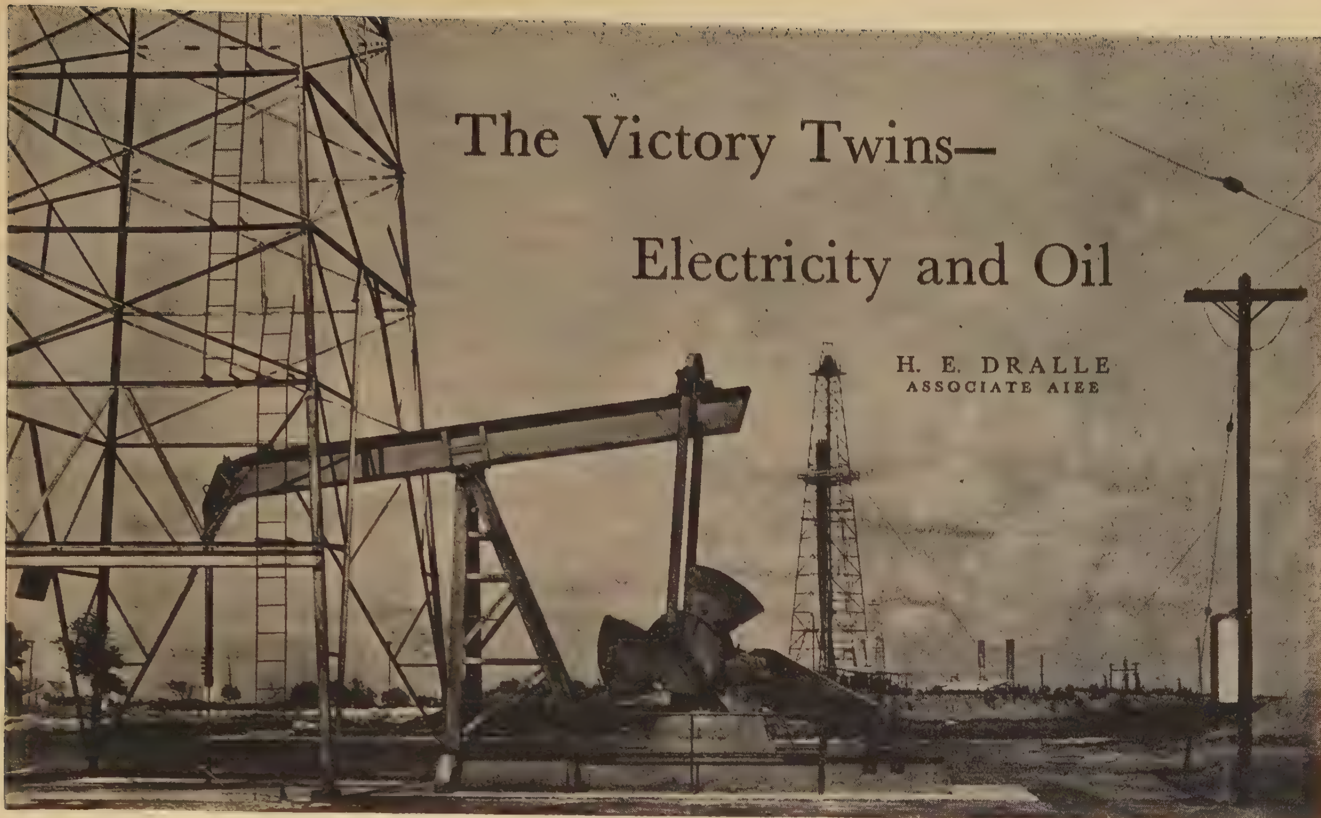
In its approach to the project the American Standards Association had the advantage of counsel from an advisory committee, composed of individuals from such organizations and agencies as the Bureau of Foreign and Domestic Commerce, National Bureau of Standards, American Society for Testing Materials, Chamber of Commerce of the United States, Export Managers Club, National Foreign Trade Council, and several industrial concerns with long experience in matters of standardization as applied to export goods. Most fortunately, the association also had the advice, assistance, and endorsement of the Office of Coordinator of Inter-American Affairs in its endeavors, which was most helpful in perfecting the requisite arrangements.

After the completion of the necessary formalities, the American Standards Association established an inter-American division in its New York office in December 1942, headed by a man of long experience in Spanish and Portuguese markets. As field representative in South America the association was fortunate in securing the services of an engineer and sales executive who has spent many years there and is thoroughly acquainted with the language, customs, and needs of various countries. His headquarters will be in Buenos Aires, where he has lived for several decades. Representation in Brazil has been provided by enlisting the part-time services of a sales executive who is also head of the technical committee of the American Chamber of Commerce in Rio de Janiero. It is hoped that this work will be enlarged very shortly and that full-time representation will soon be available in several of the important centers of Brazil.

According to the new program, the American Standards Association will exchange technical data with the other American republics in the development and use of standards, furnish information on the standardization work being done in the United States, and provide them with Spanish and Portuguese translations of standards which may be of special interest and value. In general, the idea is to provide such a thorough interchange of technical data and information that as a result, all of the countries of the Western Hemisphere will have standards as much alike as possible.

We must not allow ourselves to believe that this initial step, gratifying as it is, is a completed task. It is a move in the direction of adequacy, but only a small one, in view of the field to be covered. A definite beginning, of the right sort, we think, has been made. The undertaking, however, is extremely large, both geographically and from the standpoint of things to be done. We shall have to work extensively, but should be equipped to work intensively in certain areas at the same time. Do not forget that our alert competitors from the Eastern Hemisphere have been tilling the ground systematically for a long period of years and that representatives from the United States must quicken their efforts to overcome existent handicaps.

The American Standards Association, acting on behalf of its constituents, and with the indispensable assistance of its advisory committee on inter-American co-operation, is making a determined attempt to fortify and enlarge its initial undertaking, to the end that the opportunities now open in the field may be met and that mutual good may result therefrom. All parties who are interested in the wider spread of inter-American co-operation in the adoption of standards are assured of a hearty welcome as supporters of the movement.



The Victory Twins—Electricity and Oil

H. E. DRALLE
ASSOCIATE AIEE

Electricity is indispensable in the finding and drilling for oil, and in the pumping, refining, and transportation of oil; electricity and oil are the victory twins which shall aid us in fighting and winning the war, declares this specialist in the application of electrical machinery in the oil industry.

MANY products will be required in the winning of the war, but no two are more essential than electricity and oil.

Since both oil and electricity are forms of energy, it might appear at the outset that they are always competitors. But far from that, they are close collaborators. Electricity today officiates at the discovery, bringing forth, and development of oil into refined, useful, and necessary products. Conversely, oil is essential to the generation of electricity as insulation, lubrication, and often as fuel. Thus they are indispensable to each other, and have virtually become victory twins.

Although petroleum—oil—is one of the oldest natural products used by man, its origin and the extent of the supply stored in the recesses of the earth are still a matter of conjecture. Each generation, each decade, brings forth new truths to add to the ever-growing petroleum lore and to disprove the errors and deficiencies in our theories of yesterday.

The uses of oil are as old as history. Down through the ages it has been closely associated with the accomplishments and advances of civilization. Oil and natural gas seeping to the surface of the earth unquestionably furnished fuel for the fire to which primitive man paid devotion. The fire worshippers (Zoroastrians) built their altars near the burning gas wells at Baku (Russia) on the Caspian Sea; and today a shrine there marks the early manifestations of what was supposed to be a great imprisoned spirit.

The ancient peoples used petroleum in primitive ways centuries before the Christian era. Noah's band calked the ark with "pitch," evidently a form of petroleum gathered from the shores of the Dead Sea. Little Moses' basket which floated among the bulrushes was also lined with pitch. Nebuchadnezzar's masons used asphalt as mortar in his Babylon palace. The "slime" used as mortar in building the Tower of Babel and other ancient structures is believed to have been petroleum.

Numerous legends indicate that the Greeks recognized the usefulness of oil. They destroyed a Scythian fleet by pouring oil on the sea and setting it afire. Belisarius, a famous general of the later Roman Empire, adapted this idea of using "burning water" in his campaign against the Vandals in Northern Africa; he smeared swine with oil, ignited the oil, and then drove the blazing, squealing, cooking porkers into the ranks of the terrified enemy. The Chinese are known to have used both oil and natural gas.

Essential substance of a paper presented before the AIEE Pittsburgh Section December 8, 1942 and before the Philadelphia Section February 8, 1943.

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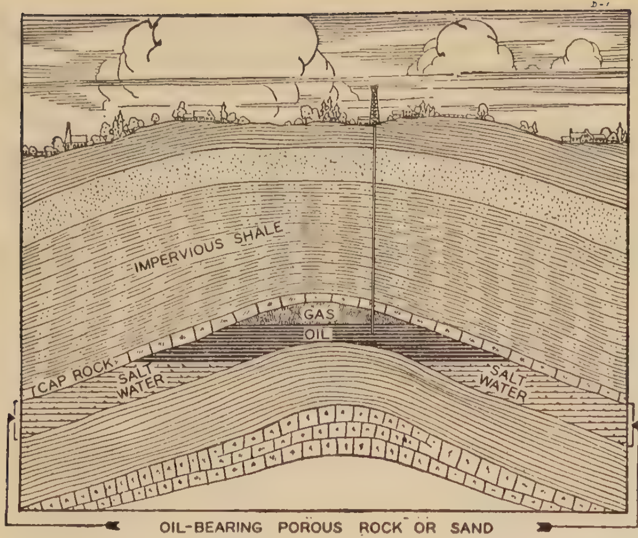


Figure 1. Oil trapped in nature's reservoir

But for all its varied uses, petroleum is mentioned most frequently in legend and in history as a curative for all of the ills of man and beast. The early Europeans coming to America found the Indians using crude oil as a medicine. Even within the span of our own lives, opportunities were plentiful to purchase from a "corner" dispenser an innocent-looking bottle of "Seneca Oil," guaranteed to cure any bodily ailment falling between the limits of dandruff and flat feet.

In this simple medicinal stage, the consumption of petroleum imposed no great problems of production; however, when the values of petroleum for lubrication, fuel, and other refined products were realized, its uses grew to proportions that even the most imaginative could not contemplate and that most of us still do not appreciate fully. Deprive us of oil with its gasoline, lubricants, plastics, rubber, explosives, perfumes, face powders, and thousands of other items that contribute to the high-standard American way of living, and our life rhythm would slow down to a snail's pace.

But, fortunately, we are not going to be robbed of petroleum and its products which are destined to play such an important part in the victory which must be finally ours. A continued supply of some of the most vital war materials is assured from the more than 500,000 producing oil wells in the world today. Even though we have lost control temporarily of some of these wells—in Poland, Rumania, Russia, Java, Sumatra, Borneo, Burma—this does not affect our operations too seriously, as the United States is blest with abundant oil supplies—over 60 per cent of the world's total. The combined output of the fields that have fallen into Axis hands and are temporarily lost to us is but 10 per cent of the world's total. Over 85 per cent of the world's oil supply is still under Allied domination, and over 70 per cent of this is in America. We have, therefore, direct control of production to meet the severest war demands. On the other hand, the very small supplies now available to the Axis very well may mean an abrupt ending of their resistance. If their limited day-to-day production had not been bolstered by tremendous storage reserves, their mechanized activity would have suffered more noticeably even before this.

WHERE OIL IS FOUND

In a span of less than 85 years the gigantic oil industry has grown from a small beginning to its present proportions which account for an annual consumption of about 2,000,000,000 barrels. Fast-moving and changing world events are constantly increasing the demand for oil. To keep pace with the growing requirements of the times America must lead the world now—as she has in the past—in the development of new and improved methods of finding, producing, refining, and transporting oil and its essential products.

Contrary to popular belief oil is not found in underground pools, but is held in porous sands or rocks, illustrated in Figure 1, much the same as water can be held in a sponge. When an oil-bearing sand is tapped, gas pressure forces the oil to the opening, and we have an oil well. In the early days of the industry, "oil witches," "peach twigs," and other supernatural devices were used for divining the presence of oil. Drilling near cemeteries or on the right-hand forks of certain creeks and other superstitious notions also had their day. Playing "hunches" in finding oil deposits is still somewhat in evidence, but the modern search for oil is conducted along scientific lines. Application of scientific knowledge, made possible in large measure by electricity,

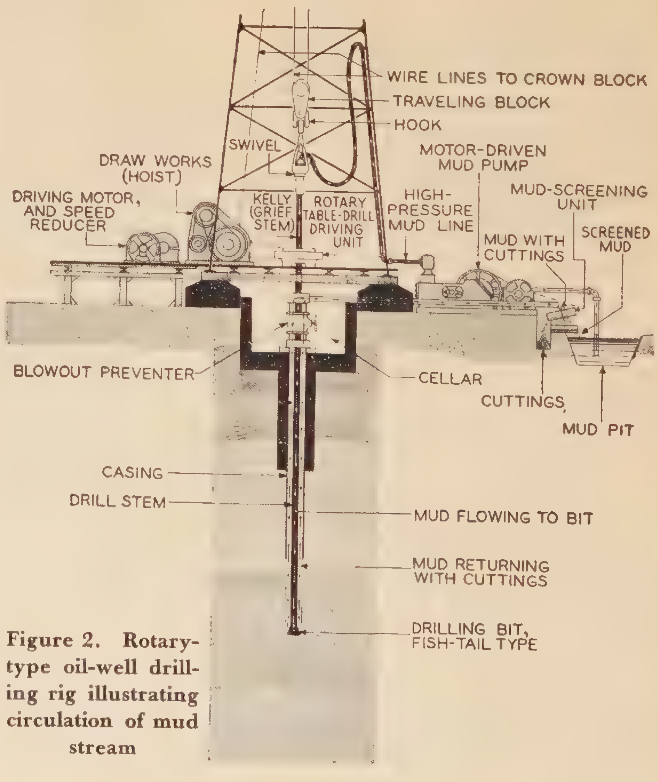


Figure 2. Rotary-type oil-well drilling rig illustrating circulation of mud stream

goes far in removing many uncertainties regarding the existence of formations favorable to oil deposits, but does not assure definitely the presence of oil. Only by drilling can we tell whether an oil pool lies hidden beneath the earth's surface.

The first oil well to be drilled (as distinguished from digging) was in Titusville, Pa., and is now known historically as the Drake well. Completed within the short time of four months to the astounding depth of 69½ feet, it was drilled by the method now known as "cable tool"—employing an old steam engine, a hemp rope, a steel bit, and a crude wooden windlass. This experiment proved the soundness of the idea of *drilling* for oil and marked the beginning of modern drilling methods, by which it is possible not only to drill a few thousand feet in several days, but to reach the existing record depth of almost three miles.

DRILLING

Let us consider briefly the drilling technique to see how electricity has helped in drilling, in the United States alone, more than 350,000 producing wells, varying in depth from a few hundred to 15,000 feet. If all of the wells which have been drilled were combined to form a single excavation, it would make a sizable tunnel (about 14 square feet in cross section) through the earth.

Today the most common form of drilling is by the rotary method, illustrated in Figure 2. The steel derrick which may be as much as 160 feet high supports, lowers, and raises by block and tackle the sections of piping used for drilling and casing the well.

The "bit" or "cutting tool" is attached to the lower end of the round hollow drill stem, made up of 20- to 40-foot joints of special drill pipe, and screwed together to any length the depth of hole requires. At the upper end is a hollow square section called the "Kelley" or "Grief stem" which passes through a square hole in the table to permit rotating the entire length of drill pipe and bit at speeds up to 350 rpm or even higher, depending upon the earth formation encountered and type of bit used. This table may be driven directly by a separate motor or by a chain from the hoist motor. Horsepowers as high as 250 are required for the rotating operation.

As the bit rotates, cuttings result. These cuttings are carried to the surface by the mud stream, drawn by reciprocating pump from the mud pit, pumped down through the drill pipe, out of the bit, and up through the annular space between the drill pipe and the walls of the hole, back to the mud pit, completing the mud-pumping cycle. Motors up to 400 horsepower are used on these pumps.

The other important part of the drilling rig is the draw works (Figure 3) which rests on the derrick floor. The draw works includes a multispeed hoist, on which is wrapped the cable that extends through the crown block (in the top of the derrick), and the traveling block

Figure 3. Draw works and traveling block on drilling rig

to form the "block and tackle" which supports the drill pipe. As drilling progresses, the driller allows the drum to rotate, "paying out" cable and thus permitting the drilling tool to progress downward. When the upper end of the "Kelley" reaches the rotary table, another section of drill pipe is inserted, and drilling is resumed.

Figure 5 shows a typical motor rated 400 horsepower, 900 rpm, for driving the draw works. Note the separate motor atop the main motor to supply safe cooling air to the main motor, which often operates on heavy loads at very low speeds and hence would have difficulty with self-ventilation.

With well drilling to depths of two and even three miles, the mechanical problems become increasingly important. It is difficult to realize that, if the bit at the end of a drill pipe 15,000 feet long should stick, electric meters at the surface instantly would record increased load, but several seconds would elapse, and there would be 15 to 20 complete turns of the drill pipe at the top before the table would stall.

As drilling depths have increased, the *need* has also increased for greater power in order to permit wells to be completed within reasonable time. It is not uncommon now to drill completely a well 10,000 feet deep within a month. Contrast this with the Drake well which required about four months to drill 69½ feet. It is not many years since electric motors of 250-horsepower rating on the hoist of a drilling rig were considered large. Today 600-horsepower motors are in use and 800-horsepower motors are being contemplated. The largest electric drilling rigs in existence are of the d-c variable-voltage type, having a total continuous generating capacity of 1,200 horsepower, and utilizing, on the draw works, motors rated 600 horsepower. Obviously short-time or peak loads greatly in excess of these can be handled. The capital investment in such electric-power equipment may run as high as $70,000 to $75,000, which is only one third of what the total investment may be on the drilling rig.

All this electric equipment too is controlled by the driller from his station on the derrick floor. Figure 7 shows the control wheels and meters used on a variable-voltage d-c drilling equipment. In principle, the functioning of this equipment is similar to that of an elevator—it is smooth, flexible, and powerful, for handling easily tool strings that may weigh 100 tons or more.

In well drilling, electricity has many other uses, in addition to those already mentioned. It is used at all well depths to bring back important subsurface evidence of the structures penetrated. This technique is known as electrical well logging.

Under normal conditions, well drillings are completed in America at the rate of nearly 30,000 per year. At present, however, because of restrictions due to shortages of critical materials, drillings are completed at the rate of only 20,000 per year. Of this number almost 23 per cent come in dry and are called "dusters."

These new drillings are necessary to locate new reserves, to supply more oil to meet the constantly increasing demands, and to meet the production requirements for wells that have been abandoned.

OIL WELL PUMPING

When a well has been completed in a productive sand, the gas pressure may be sufficient to bring the oil column to the surface. In such case the well is said to "flow." With decreasing gas pressure, flow rate decreases until it is necessary to raise the oil to the surface by some method of pumping. In this operation again, electricity is particularly useful, whether the wells are pumped in groups by means of central pumping powers (a common form of pumping for light wells), or singly as individually operated and self-contained units.

In the individually operated wells we may have both the electric motor and the centrifugal pump at the bottom of the well. In this type of unit both motor and pump are integrally connected and supported from the tubing which carries the oil to the surface. Leads for supplying electric power to the motor are clamped to the tubing. This type of submersible unit is particularly adaptable where large volumes of fluid are to be handled. Often only a very small percentage of the total fluid is oil, the rest being salt water.

The most common form of individually pumped well is the type in which the reciprocating pump is supported by the tubing at the bottom of the well and is actuated by a string of sucker rods mechanically connected to the walking beam and the electric motor on the surface.

Formulas developed from a series of comprehensive tests utilizing electric instruments and magnetic strain gauges in recording simultaneously stresses at 14 different points in the mechanical pumping system between the motor on the surface and the pump at the bottom of the well, enable one to calculate the horsepower rating of the motor to apply on any well. Such motor-driven wells are particularly adaptable to automatic operation, with electric time clocks which automatically start and stop, at prescheduled times, wells that should not be pumped continuously. Automatic operation greatly increases the number of wells that can be attended by a single operator and, at the same time, minimizes the possibility of errors attendant on manual operation. The opposite extreme is illustrated by a native-owned, hand-operated pumping well in Burma, where eight to ten men and women raise to the surface from a single 300-foot well 15 to 20 barrels of oil in one day. Instead of one man operating 25 to 30 wells, as is entirely possible with automatic time clocks, here are 10 or 12 persons on a single well. Oddly enough, that particular field at Yenangyoung, which is now under Jap domination, is over 95 per cent electrified for all operations—perhaps the most completely electrified field in the world.

OIL TRANSPORTATION METHODS

Since our areas of greatest production and refining of oil are quite remote from the large centers of population, oil transportation becomes for us an important economic problem. The millions of barrels of crude oil brought to the surface daily must be delivered to refineries where the oil can be broken down into its usable products, and these refined products, in turn, must be delivered to their points of use. In the transportation of oil and its products, the most generally used means are tankers, pipe lines, barges, railway tank cars, and trucks, in the order of their cost per barrel of oil handled. If we assume that we wish to get oil from the Gulf Coast of Texas to New York (2,000 miles by tanker, 1,600 miles overland), the transportation costs per barrel by the different methods are approximately as follows: tankers 20 cents; pipe lines about twice that much; railway cars about twice as much as the pipe line, or four times as much as by tanker.

Since the tanker provides haulage between coastal points at the lowest cost per barrel, this method was used chiefly before Pearl Harbor to bring, from our Gulf Coast and the South American countries, the 1,400,000 barrels of oil required daily on the Atlantic Seaboard. The submarine menace, as well as the diversion of tankers to lend-lease and other activities in both the Atlantic and Pacific, made necessary the employment of other methods of getting the much needed oil to the Eastern Seaboard from our Gulf Coast and midcontinental areas. Although efficient use of existing railway tank cars, barges, and trucks has made it possible to provide the East with over 800,000 barrels per day, to obtain the necessary additional oil the pipe line offered the most expansible method, appraised from the standpoint of least time and power required and the least expenditure of critical materials.

More tank cars would require more locomotives; more barges would require more power boats, more canals, and canal improvements; more trucks would require more rubber and more man power. Expenditures in critical materials and horsepower for these improve-

ments had to be weighed against increased building of tank ships and related convoy equipment. So steel and power became the controlling factors in the selection of pipe lines as the most desirable method of expansion.

Children of this situation are the world's largest products line and the world's largest and longest crude-oil line. Both are electrically welded and electrically operated. The products line, known as the Plantation

Figure 4 (below). Interior of Plantation Pipe Line pumping station showing 900-horsepower 3,600-rpm explosion-proof squirrel-cage motors—the largest of this type ever built

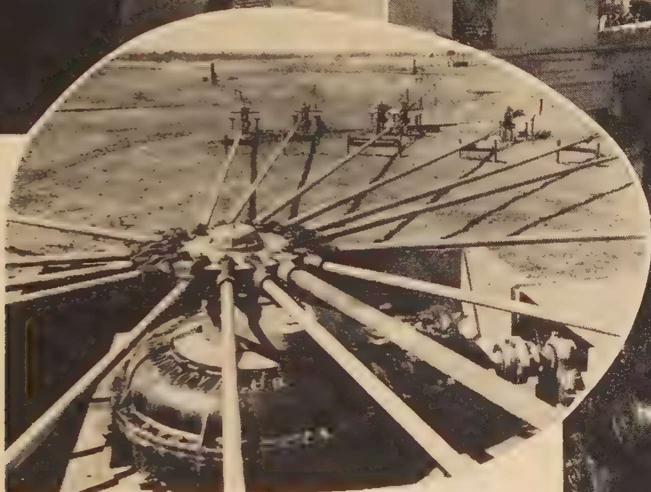


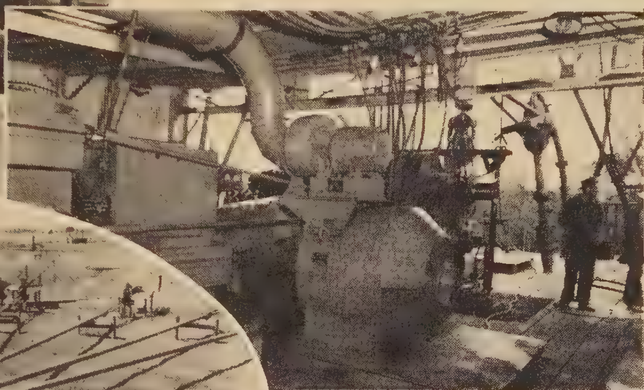
Figure 6 (above). Central pumping power operating 16 wells from a single motor

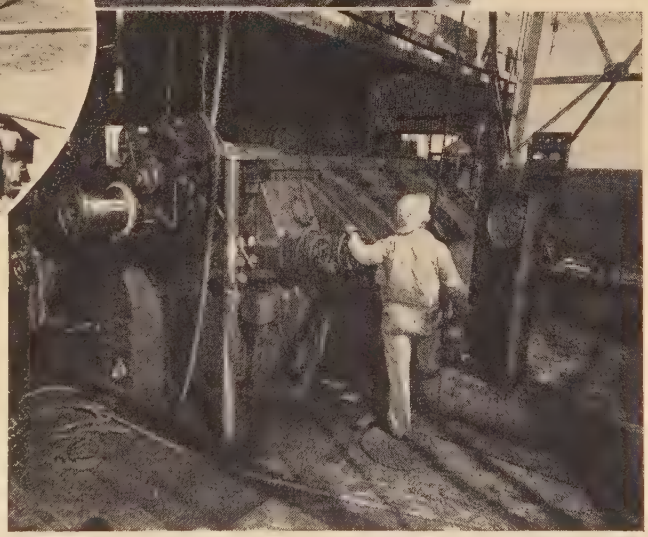
Figure 7 (right). Control wheels on draw-works post at drillers position for operating world's most powerful d-c variable-voltage drilling rig. Load meters in full view of driller on derrick floor

Pipe Line, running between Baton Rouge, La., and Richmond, Va., is made up of 12- and 10-inch diameter pipe for the main line to Greensboro, N. C. (800 miles), and 8- and 4-inch diameter pipe for the branch lines (650 miles). This line takes in daily at Baton Rouge 90,000 barrels of refined products of eight different grades (gasoline, kerosene, Diesel fuel, and others) and delivers them at odd points in the South and Southeast, over its 1,450-mile length as efficiently as a railroad delivers fruits and vegetables from Florida to New York.

Tenders of oil are dispatched through these systems much the same as trains are dispatched on a railroad. Deliveries of products from a pipe line may be made simultaneously at a number of different points, and some points may require shipments to different marketing companies. In the case of the Plantation Pipe Line, the complex and ever-changing dispatching function for the entire line is centralized in a dispatcher's office in Atlanta. All pumping stations and delivery points are connected to the dispatcher's office by a teletype system providing continuous recorded intercommunication. From the dispatcher's office are issued all orders governing the routine operation of the line, including starting and stopping of stations and individual units within the

Figure 5 (below). 400-volt 900-rpm d-c motor connected through reduction gear to draw works. The explosion-proof motor-driven blower brings safe ventilating air to main motor





stations. Without electricity in these many diversified applications—communications, power, lighting, automatic control—these operations could not be carried on so effectively.

Figure 4 shows the interior of one of the main pumping stations of the Plantation Pipe Line. These 900-horsepower 3,600-rpm, totally enclosed fan-cooled explosion-resisting motors (the largest of their type ever built) drive centrifugal pumps that daily push through the

1,450-mile system the 90,000 barrels of refined products.

Starting and normal stopping of these individual units within each station are controlled by the station attendant. Prevention of starting and protective shutdown of units and stations are accomplished automatically when conditions arise that exceed preset safe limits of operation from the standpoint of either temperature or pressure. When automatic shutdown results from such excesses, not only is an audible signal given to warn the station operator, but a light indication of the specific protective function is also given to permit quick and easy attention to the part in distress.

The duties of the attendant incident to the starting and stopping of main-line units are simplified by providing in one complete-sequence automatic operation for the valves, motor control, and pressure devices concerned. Thus relieved from a routine performance of manual operations at different points in the station, the operator can devote his attention to the over-all process and to the results obtained.

One of the critical features of multiproduct-line operation is the prevention of intermixture of different successive shipments called "tenders" as they move end to end through the line and the pumping stations. To accomplish this, it is necessary to maintain velocity in the line higher than a critical minimum amount. At any lower velocities, a phenomenon akin to laminar flow takes place, with greatly increased intermixing. Obviously, this places an unusual premium upon the reliable operation of the pumping equipment.

Oil travels through a pipe line at three to five miles per hour; consequently, about nine days after a product is started through the line at Baton Rouge, it would make its appearance at Greensboro, over 800 miles away. Of course, it would not appear until the line is completely filled. The Plantation Line has a storage capacity of more than 500,000 barrels.

The new 24-inch crude-oil line, popularly known as the "Big Inch" line, now being built between Longview, Tex., and the Eastern Seaboard by War Emergency

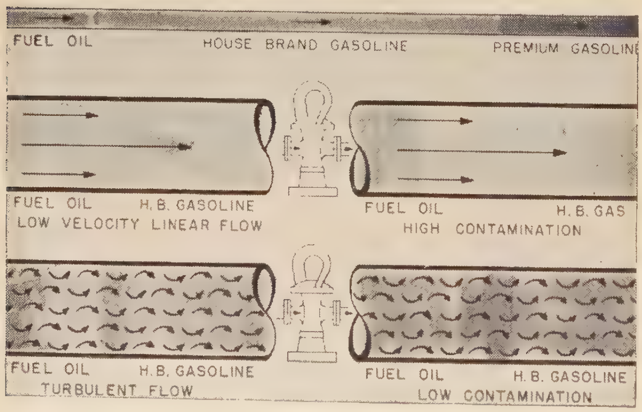


Figure 8. Diagram showing how a pipe line transports different products. To minimize contamination, velocity is maintained in the turbulent range

Pipe Line Company, a distance of 1,388 miles, will have a storage capacity of approximately 4,000,000 barrels, the equivalent of one day's production of all the wells in the United States, or 65 per cent of the world's daily total oil production. Here are some other interesting facts about this world's largest crude oil line:

1. It is now practically completed between Long View, Tex., and Norris City, Ill.—550 miles in less than six months after starting. By June 1943, it will be fully completed to the Seaboard, 1,388 miles.
2. It will handle 300,000 barrels of oil daily.
3. Its carrying capacity is equivalent to 85 notional tankers averaging 75,000 barrels capacity and operating between Gulf ports and Eastern Seaboard (about 2,200 miles) at a ten-knot speed.
4. The pipe line will increase deliveries to certain overseas points with no more steel than would be required for tank ships in comparable delivery, with savings in power, man power, and money cost.
5. The line will operate at 750 pounds pressure.
6. It is powered by 126,000 horsepower in main motors in the form of 84 units, each rated 1,500 horsepower, 1,775 rpm, and generally arranged in 28 stations with three motors per station. It will have three pumps in each station operating in series.
7. Power for the 28 stations will be supplied by 16 different power companies between Longview and the Seaboard.
8. Eight different contractors worked simultaneously in welding electrically and laying the 24-inch pipe on different sections of the line. As many as seven miles were laid in a single day.
9. The line required about 365,000 tons of 24-inch steel pipe, having a wall thickness of $^{7}/_{16}$ inch. It will deliver 0.82 barrels of oil per day per ton of steel used, which is about a standoff, when compared with a tank ship, in steel efficiency. This figure compares with 0.50 barrels per day per ton for barges and 0.52 for tank cars.
10. There is some talk of stepping up the capacity of the line from 300,000 to 450,000 barrels per day. This would require 250,000 additional horsepower, or 200 per cent increase in power for 50 per cent increase in capacity.

The economic and transportation changes requiring the building of such large lines have also required supplying other feeder lines from important producing fields and the modification and actual reversing of other lines already operating. Among these projects were reversal and conversion of a Texas company pipe line between Port Arthur and Dallas; reversal and conversion of the (Atlantic Company) Keystone line (now crude oil) across Pennsylvania, from Pittsburgh to Philadelphia; enlargement of the Shell line from Wood River, Ill., to Lima, Ohio; reversal of the Sun-Susquehanna products line from Cleveland to the Eastern Seaboard; reversal of the Standard Oil Company of New Jersey Tuscarora pipe line from the Ohio–Pennsylvania border to New York; enlargement of the Texas Empire line between Tulsa and Chicago; opening of a new products line across Florida (35,000 barrels per day), and numerous others.

In addition, other larger oil lines will be in process before the end of 1943. A 20-inch products line to par-

allel the war emergency crude line is being built and may be completed to the Eastern Seaboard by the end of 1943. If it is, electric power of the order of 100,000 horsepower will be required to operate it.

REFINING

Consideration should also be given to the economic contributions which the refining branch of the oil industry has made in supplying our constantly expanding armada of ships, planes, tanks, and mechanized equipment for war. Long and patient research by the refiners over the years has transformed crude petroleum into a veritable treasure chest from which are now being obtained a thousand and one needed substances—aviation gasoline, toluol, new alcohols, acids, solvents, perfumes, pharmaceuticals, special lubricants, organics, and synthetics of every type, including rubber.

Not long ago it was believed that the ultimate in motor fuel would be reached by creation of a gasoline equivalent to pure iso-octane in power and antiknock qualities. So superior was iso-octane in these qualities that it arbitrarily was given a number of 100 to become the standard by which all gasolines would be evaluated. But this was before the battle of Britain.

The epic fight of the Royal Air Force to save England, and incidentally the democratic world, was also a chemists' fight to produce fuels that would get planes into the air in shorter time and permit them to fly faster and farther than their adversaries. The American chemists of our refineries were in the fight, because they knew then and know now more about fuels than any one else on earth. The battle of Britain became a developing and testing laboratory that has brought forth changes in motor-fuel technology, the effects of which will be in bold evidence long after the war. Fuels are already being made that go beyond the octane scale—estimated as high as 125 octane—that will produce 50 per cent more power than 100-octane fuel. The large quantities of this fuel that are available have enabled engine and airplane designers to produce more powerful and speedier planes. The importance of this superior fuel is being demonstrated graphically as the American air program moves into full swing.

Toluene, best known as the basis of one of the most important high explosives (TNT), used in shells, grenades, depth bombs, and aerial torpedoes, is a refined product of petroleum.

Special lubricants, so highly important to military forces on land, sea, and air, must function efficiently under the exacting and varying conditions of modern warfare. They, too, are products of petroleum refining.

And now synthetic rubber—the crowning achievement of the refinery. Pearl Harbor and the quick succession of grave events that immediately followed placed us in the position of "have nots" from the standpoint of natural rubber on which our daily lives so greatly depended.

Figure 9. Portable mass spectrometer for analyzing gases accurately and quickly, qualitatively, and quantitatively

The present rationing program brings home to us the importance of this commodity to our very existence and gives us a better appreciation of the Herculean task undertaken by industry of producing synthetic rubber at a rate that will permit our obtaining much for civilian use in 1944. The most prolific source of the base materials of synthetic rubber is petroleum, and the refineries have moved rapidly in changing their plants to provide large quantities of butadiene and styrene in order to produce new rubberlike material of even broader and more promising utility than natural rubber.

The perfection of cracking processes that permit greater yields of materials for rubber production has the practical effect of increasing enormously the Nation's petroleum reserves and in extending the usefulness of oil.

In all of these developments, electricity has been a worthy victory twin of oil—they have grown to man size together.

Changes in refinery operations to meet specific demands for many specialized products have necessitated, not only the increased use of electric power, but also new and improved types of electric apparatus to meet exacting operating requirements in refineries. Provision of testing facilities to permit the furnishing of underwriters' labels on explosion motors of ever increasing horsepower ratings are being expedited. On present applications requiring explosion-proof motors of these higher horsepower ratings, it has been customary to follow construction practices that have proved successful for smaller ratings. Such motors are built with mechanical parts suitable for operation in both corrosive and explosive atmospheres. These are getting the job done in good fashion.

Control equipment, too, has been improved constantly to provide greater safety, to conserve space, and to simplify installation—all in keeping with the accelerated program of doing more, safely, in less time with less man power. As heavy spot loads have been added to electric systems already well loaded, it has been necessary in many plants to make power-distribution and system-stabilization studies to apply equipment of proper

interrupting capacities for full protection of apparatus and the power circuits. The calculating board has greatly facilitated these studies and has increased the reliability of the systems.

ELECTRICAL ANALYSES

Both the 100-octane-gasoline and synthetic-rubber programs necessarily deal with complex hydrocarbon mixtures, the analysis of which is long and tedious by present fractionation methods. More accurate analyses in shorter time are desirable. Electricity will solve this problem too by means of the mass spectrometer, which analyzes mixtures by separating out different elements according to their molecular masses. Samples as small as one cubic centimeter at atmospheric pressure may be easily analyzed. Intensive co-operative research is now going on to make this electrical analyzing device an everyday tool for important laboratory analyses, and its use may be extended even to process control.

In the marketing phase of the oil industry, too, electricity is definitely allied with oil. A small explosion-proof electric motor, automatically set in motion by pressing the valve on the filling-station hose, pumps into your car the weekly three gallons of gasoline; and for pumping up your tires an automatically operated pressure-controlled motor-driven compressor supplies the air. In the good old days in the memory of all of us, in fact in 1942 B.R. (before rationing) there were 450,000 such service stations in America, each with one or several such pumps. No doubt many of these will shut down, but there still will be left a goodly number in our filling stations.

And so we see that in all phases of this large and essential oil industry, electricity is indispensable and has shown itself a worthy Victory twin for oil. Its numerous uses everywhere have greatly accelerated accomplishments and simplified our task of becoming the "filling station" of the democratic nations of the world.

Joseph Slepian—Lamme Medalist

"For his contributions to the development of circuit-interrupting and circuit-rectifying apparatus," Joseph Slepian was presented the AIEE Lamme Medal for 1942, which was established by the will of the late Benjamin Garver Lamme, at the recent AIEE national technical meeting in Cleveland, Ohio. This 15th presentation ceremony was opened by S. B. Williams, chairman of the Lamme Medal committee. L. W. Chubb outlined the achievements of the medalist.

The Lamme Medal

S. B. WILLIAMS
MEMBER AIEE

UNDER the terms of the trust established in the will of Benjamin Garver Lamme, who died 19 years ago, was the stipulation that the Lamme Medal shall be given annually "to a member of said society (AIEE) who has shown meritorious achievement in the development of electrical apparatus or machinery." The donor of this award was one of those American electrical immortals whose basic discoveries and teachings will live to inspire electrical men as long as there is an electrical art.

Some awards are made to perpetuate a man's name—they are monuments to his contributions to progress and serve the noble purpose of stimulating others to emulate his determination. Mr. Lamme, however, had an entirely different idea in mind when he inserted that provision in his will. He was a modest man and sought no honors in life; neither did he wish for them posthumously. To him an award was a living vital thing, provided it stimulated initiative. All his life Mr. Lamme was interested in men and in helping them do that for which they were best fitted and talented. This award, therefore, represents the unwillingness of a man to let the grave prevent him from encouraging endeavor. Death could not and did not silence that spirit.

But Mr. Lamme left this world a generation ago at a time when the electrical industry had not yet reached its maturity. He lived during that period when great engineering individualists not only flourished but were necessary for the exploration of vast new uncultivated areas. But as an art matures, and narrowing frontiers change development from one that is extensive to one that is intensive, many specialists take the place of the few big

S. B. Williams is editor of *Electrical World*, New York, N. Y.

minds that had wide vision. More and more we see development come by way of collaboration of these specialists.

On the other hand, as long as the art is strong and vigorous, we shall have new machinery and new apparatus. In this respect Mr. Lamme's vision has bridged the two decades since his death and will bridge many many more.

In the past we have been able with this award to recognize a brilliant array of individual achievements. And this year's medalist will add further luster and glory to the award through the brilliance of his research.

But change is taking place today—change from individualism to collaboration. Those who had the privilege of being close to Mr. Lamme know that he was an advocate of change. He cared not who was responsible for change—1 man or 20—provided there was progress. If he were living today, would he not interpret "for meritorious achievement" to mean also the direction and stimulation of the collaboration that resulted in new and important forms of electrical machinery and apparatus?

It seems to me, as it does to others on this and past Lamme Medal committees, that some way can be found, without lowering the bars, to acknowledge this change in research responsibility while perpetuating this recognition of achievement that Mr. Lamme had in mind when he inserted this provision in his will. We owe it to him, and we owe it to those splendid electrical engineers who have received this medal, to maintain the dignity of the award—we also owe it to succeeding generations to maintain the stimulus to great deeds afforded by the donors.

A medal is a living thing. Properly awarded, it grows in prestige with the years.

Joseph Slepian—Engineer, Inventor, Scientist

L. W. CHUBB
FELLOW AIEE

To the uninitiated, award of the Benjamin Garver Lamme Medal to Joseph Slepian seems remarkable, because the recipient was never formally trained as an electrical engineer. We who know the man and his work see nothing unusual in his selection for this honor, because we realized long ago that he is one of the great engineers of our time.

But Doctor Slepian is more than an engineer. Trained as a mathematician and a physicist, he is a true scientist and a prolific inventor. Most inventors have a high percentage of accidental triumphs, but Slepian's successes are the result of theoretical analysis and the dreams of a scientific man. He has always found his solution by seeing a need, analyzing the situation, working out a method on paper, and proving it in the laboratory.

Some years before the copper-oxide rectifier was invented accidentally, Dr. Slepian's mode of scientific reasoning led him to the conclusion that there should be an asymmetrical conduction across the junction between copper and copper oxide. He built such a rectifier with layers of copper oxide and copper, but it required an accident in which the oxide was formed on the parent metal to catch up to his theory.

Some of his inventions were so far ahead of the times that the patents expired before they were extensively applied. Two of these are in the field of electronics—the electronic multiplier, depending on secondary emission, which was issued early in 1923, and an electron accelerator, issued in 1927 and just now becoming of great interest in production of high-energy electrons.

As an engineer, Doctor Slepian is unique in that his education and early experiences all pointed him toward an academic career. Son of an immigrant Russian tailor in Boston, he was a brilliant student of mathematics and science in the public schools and entered Harvard University at the age of 16. He was graduated in 1911 and remained at the university until he received a doctor's degree in mathematics in 1913. As a Sheldon fellow, he spent another year as a postdoctorate student at the University of Goettingen in Germany and at the Sorbonne in Paris. When he returned to America, he became a mathematics instructor at Cornell University and, as far as anyone could tell, was permanently rooted in the academic soil.

Fortunately for the profession to which we belong, he did a sudden about-face, resigned his instructorship, and started an adventure which resulted in his enlistment in the ranks of industrial research. He came to the Westinghouse company as a graduate student, winding coils and doing other shopwork by day, and studying electrical-engineering volumes at night. This unusual grafting of a practical knowledge onto a mind already fully developed for theoretical thinking has resulted in a scientific engineer of rare excellence.

If Doctor Slepian had never left the classroom, I am sure that he would have ranked among the leading university men of these times. Our profession can count itself fortunate that he became one of us, and I often speculate on how much more slowly we would have progressed in the last two decades without Joseph Slepian.

He has approximately 200 United States patents issued and many more pending in radio, electronics, measurement, electrochemical processes, electrical machines, lightning arresters, acoustics, X rays, materials, systems of transmission and distribution, high-voltage phenomena, circuit interrupters, vapor electric devices, control, and other fields.

L. W. Chubb is director of research, research laboratories, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.

His papers, which we have learned to admire as beacons marking out the path of engineering progress, cover many fields but are particularly numerous in the fields of high voltage, arc extinction, circuit breakers, rectification, and lightning protection. Since his award is for developments in circuit interruption and rectification, I would like to call attention to some of his papers on these subjects.

His interest in circuit interruption has been continuous since his first patent covering a circuit interrupter in 1919. In his paper "Extinction of A-C Arcs," presented before the Institute in 1928, is the first statement regarding influence of circuit-voltage recovery rate on circuit-breaker arc extinction. Another paper entitled, "Extinction of Long A-C Arcs," presented in 1930, was the first to show the influence of gas motion or turbulence in oil circuit breakers, expulsion fuses, and gas-blast switches. A third paper presented at about the same time made the first statement that an arc has a growing dielectric resistance before current zero. These accomplishments of Doctor Slepian were the stepping stones to development and design of better breakers.

Joseph Slepian

His fundamental work on high-voltage phenomena, lightning arresters, and spark gaps also contributed to improvement of circuit breakers. I remember his 1928 paper on breakdown of spark gaps which originally presented the idea that space charges in the path of the first electron avalanche, distort the field and greatly accelerate breakdown, accounting for the speed of breakdown and streamer formation in spark gaps at atmospheric pressure. This theory, not widely held by those working in the field at that time, is now generally accepted by the experts in mechanism of high-voltage breakdown.

In the field of rectification, Doctor Slepian has made a direct and dramatic contribution to the safety and progress of our nation. One result of his invention and experimental development in mercury vapor devices is the Ignitron, which is in great measure responsible for the enormous production of aluminum and magnesium required for our military aircraft.

At the beginning of 1940, all industry—electrochemical transportation, central station, steel and others—had rectifiers totaling 500,000 kw in operation or on order. This represented the production of a 15-year period. In the three years since commercialization of Doctor Slepian's Ignitron, five times this capacity, or 2,500,000 kw of rectifiers have been purchased in this country, and another 1,000,000 kw have been purchased from Canada to meet the demands of war production.

The Ignitron is an outstanding improvement over former types of multianode rectifiers. Its arc drop and, therefore, the losses are approximately half of those in a conventional rectifier.

But in telling you about Slepian the engineer, inventor, and scientist, I have neglected to give you a picture of the man. My first talks with him took place 27 years ago when he submitted to us an invention for indicating a ship's speed by measuring the voltage generated in a transverse conductor, cutting the vertical component of the earth's magnetic field, and completing the circuit by electrodes in the still water on each side of the ship. That sea speedometer never amounted to much, but I believe the discussions led to employment of this unusual scientist in industrial research.

From our shops he graduated to the laboratories where he did routine and developmental testing of electrical apparatus. In a matter of weeks older and more experienced engineers were including the scholarly young tester in discussions of their problems.

When he first arrived at the engineering laboratories, I happened to be in charge and in a position to recognize his unusual qualities.

On one occasion the rest of us were so busy on some development that I could not assign Doctor Slepian to a new job at the moment. Instead of marking time until we had finished, Slepian asked my permission to study a complicated setup of large motors, electrolytic condensers, reactors, instruments, transformers, and disorderly wiring and cables in a nearby room. Permission granted, he traced the circuits and made a complete schematic diagram of the system on a large piece of paper. He did not recognize the electrolytic condensers, and I explained them to him.

Without any further assistance, he deduced that the setup was designed to explore operation of polyphase induction motors from a single-phase power line. He not only learned about this specific problem but went on from there, in a short period analyzed the general problem of phase conversion, and made several inventions for both static and rotating phase splitters. His initiative and independence have not lessened during the years since then.

Another incident in those days demonstrated his ability to tackle the most difficult assignments. Another laboratory employee whose job it was to make special tests on large machines with oscillographic apparatus was absent on a day when a short-circuit or buckover test had to be run on a large commutator machine.

Doctor Slepian was assigned to take his place, despite the fact that he was not an engineer, had never used an oscillograph, and had never been assigned to such an important and high-power test.

He did that job without missing a single picture. He did it in a scientific manner, studying the portable apparatus, learning all about the connections and controls of the complicated six-element unit, and supervising the entire setup. Even an experienced tester feels a certain timidity in handling high-power tests, but Doctor Slepian proceeded with aplomb, because he knew exactly what he was doing and why he was doing it at each step.

He is a born consultant with the ability to give a clear explanation in language exactly on the technical level of his listener. His enthusiastic, willing, and helpful attitude brings his clients back time and again with new problems.

Doctor Slepian is still a comparatively young man, only 52. He has crowded much hard work and many solid and brilliant accomplishments into those years. We who know and esteem his remarkable ability and scientific honesty expect him to spend many more years in valuable research and fruitful development work.

If Mr. Lamme could have been present at the meeting of the medal committee, he would have been pleased by the selection of Joseph Slepian. Lamme, the engineer, would be able to appreciate the contributions that Slepian has made to the development of electrical apparatus and machinery.

The Fostering of an Engineer

JOSEPH SLEPIAN
FELLOW AIEE

Doctor Chubb has emphasized my own personal role in the technical developments which form the basis for this much-esteemed Lamme Medal Award. However, man does not work in a vacuum, but lives in an environment of things, men, and ideas, which react on him and upon which he reacts. My own environment during my professional life has, in large part, been that aggregation of buildings, tools, money, men, ideas, and traditions, known as the Westinghouse Electric and Manufacturing Company, a corporation organized for manufacturing electrical machinery for the profit of its stockholders. That environment must have been propitious, or highly favorable to the development of such scientific talents as I had, or I probably would not be on this platform today. Perhaps a few words about my first experience with this organization will be of interest.

Joseph Slepian is associate director of research, research laboratories, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.

In 1916, following its financial reorganization, the Westinghouse company was a very large and successful corporation. Many thousands of people were employed by it, and the work of these many thousands was apportioned, directed, and integrated through the wonderful system of organization of the company.

A popular conception is that the organization of a large successful company is like that of a smooth-running machine. Like the cogs, wheels, and levers of the machine, each man in the organization has his own clearly defined tasks and duties, which co-operate and fit in with the tasks and duties of other men so that the whole organization functions to perform that for which it was planned.

However, and in my opinion, fortunately this conception is true in only a very rough and approximate manner. If the organization is to be compared to a machine at all, it must be compared not to a well-tuned-up smooth-running machine, but rather to one with loose play in many places, the parts of which are held together at different points by the most various strategems, but which still lumbers along in spite of a wheel slipping here, and a cylinder missing there.

For, unlike the cogs and wheels of the machine, which can be shaped precisely with close tolerance for their specific functions, the men who make up the organization are completely nonstandard. Everyone is different from every other one, and machine adjustment must be loose to accommodate itself to such variable parts.

This analogy with a machine thus becomes strained, but I shall strain it further by pointing out a quality which is possessed by the recalcitrantly nonstandard human cogs and wheels of the corporate organization but is absent in the precise cogs and wheels of the machine, and which makes the human organization a far more rugged, reliable, dependable, and adaptable organization, than the most perfectly designed inanimate machine could ever be. I have observed this quality frequently and have benefited by it continuously.

This quality of the human cog is his conscious awareness that he is part of the larger organization, and that his particular task has purpose only in relation to the functioning of the larger organization. A carburetor is indifferent to whether its motor is running properly or not.

Give it its proper adjustment, and it will continue to feed fuel to the cylinder regardless of whether the spark plug is firing or not. Not so in the human organization. When a human spark plug misses, the human carburetor alters his function, because he knows that while his set task is to feed fuel, there is no purpose in this if the spark plug is not carrying on his appointed task. Without this quality of humans, no complex organization, however carefully worked out, could ever function.

I must have been a particularly odd-shaped piece when I tried to fit into the Westinghouse organization in 1916, for very early I had reason to be thankful for the necessary looseness of organization. After working in the shops as an apprentice for most of a year, I started "on regular," as an assistant in "high-tension test" a works laboratory, in the electrical section of the research engineering department. C. E. Skinner was head of the department, and Doctor Chubb headed the electrical section. "High-tension test" was not an agreeable place, physically. It was hardly separated from the shop and was grimy, dirty, and very crowded. This laboratory made various tests for the engineering and purchasing departments, including a general oscillographic service. As I remember, my first job was measuring the resistivities of a big pile of sheets of German silver for the purchasing department.

In this laboratory, I came into contact with a number of engineers from various departments. Friendly chats grew into lengthy technical discussions. More engineers came, and presently I was carrying on a lively consulting service from "high-tension test." C. L. Fortescue was a frequent visitor, and he would sit for hours talking and working out with me some of his latest ideas. My pile of German silver strips lay waiting, untouched. The laboratory foreman, H. H. Galleher, a most kindly and lovable gentleman, would pass by and look on. I would be uneasy, because my set task, the measuring of those German silver strips was being neglected, but there was never a complaint nor reprimand from Mr. Galleher. I don't know how he adjusted his time sheets. Perhaps the normal four-hour German silver job slipped in as 10 or 15 hours. But there was enough looseness, so that it could be taken care of. I am sure that when the organization was planned, a consulting service at "high-tension test" was not contemplated, and I am also sure that at no time did any organization chart show such a service going on. But there it was, just the same, thanks to the inevitable looseness of the organization, and thanks also to Mr. Galleher's awareness that the set tasks of the laboratory had significance only in relation to the larger organization of which it was a part.

Doctor Fortescue at that time was a design engineer in the transformer engineering department, according to the organization chart of that department. But in all the time I knew him and while he was officially a design engineer, I do not recall that he designed a single transformer. He had designed many before, but now organization lines bent before his talents. I would guess that much more of his time was spent on matters relating to other departments than the transformer engineering department. Nevertheless the manager of that department, Mr. McConahey, managed somehow to swallow up Doctor Fortescue's time in his report to the salary accounting department, for Doctor Fortescue's salary continued to come through.

R. E. Hellmund was another designer, this time in the motor engineering department, who did very little designing while I knew him. He was very largely instrumental in getting me interested in the lightning-arrester problem, introducing me to A. L. Atherton, and encouraging me in the development of my first ideas in that field. I do not recall, but feel very sure that tests on these ideas were made first, and authorizing orders for these tests were issued later.

Mr. Lamme, with whom I had occasional very inspiring talks, held the position of chief engineer. As such, he had responsibility for all engineering activities of the company. But his health was beginning to fail, and it was impossible for him to attend personally to all the details called for by his position according to the organization chart. Nevertheless, he continued to occupy that position until his death a few years later, giving of himself generously where he could. The job simply adjusted itself to this great man, chart or no chart.

I hope that I have not overstated my case and given the impression that I am arguing that any and all organization is undesirable in any enterprise, however complex. That would be absurd. An enterprise involving many men must have assignment of tasks, duties, and responsibilities to various individuals if the enterprise is to function, and such assignment of duties and responsibilities is what is meant by organization. But what I do say is that it is impossible to define these individual tasks and duties in complete detail and still fit individual men in all their variability. Dependence must be placed on the individual's awareness that his immediate tasks have significance and value only in relation to the larger activity. Dependence must be placed on the individuals' good will toward that larger organization and his desire that that larger organization function well. These last are probably what is meant by good "esprit de corps." Dependence must be placed on these last to complete the definition of tasks to fit the individual's own characteristics and capacities and those of his neighbors.

The fitting into the organization of the odd man, and particularly the odd man with special talents, is not easily done by any detailed planned organizational setup. The individual cases are too variable. But a good "esprit de corps" will take care of such situations, shifting the nonrigid organizational lines to meet the particular situation. The examples I have given show that beneath the frustrations and dissatisfactions which are part of the daily life of every man, a good healthy "esprit de corps" existed at the Westinghouse company.

Ultrashort Electromagnetic Waves
VI—Reception

BERTRAM TREVOR

Mr. Trevor deals with the reception of ultrashort electromagnetic waves over line-of-sight paths under practical conditions. He shows that, when directive antennas are employed, there is an optimum antenna height for which the direct and reflected rays are received in phase producing maximum effect. The concept of excess-noise ratio is developed which evaluates the merit of a receiver in a manner independent of band width, receiver impedance, signal-generator impedance, or frequency. This is the concluding article in a series of six on ultrashort electromagnetic waves. The material contained in these articles was originally presented as a series of lectures before the basic science group of the New York Section at Columbia University. A consolidated reprint will be available (see announcement elsewhere in this issue).

PAUL C. CROMWELL, Chairman, Symposium Committee
(College of Engineering, New York University, New York 53, N. Y.)

In recent years there has been much progress in the field of reception using ultrashort electromagnetic waves. Unfortunately, it is not feasible at this time to disclose some of the more interesting developments associated with the war effort. Our discussion concerns fundamentals which are applicable to reception in general, and in particular to the higher frequencies which are not reflected by the Kennelly-Heaviside layer, or so called ionosphere.[1–6] No very sharp division can be made between these two regions, since the ionization of the upper atmosphere is so variable with time of day, season, and sun-spot cycle. Strong signals as high as 45 megacycles per second have been received from Europe by way of sky wave reflection.

PROPAGATION

The ultrashort waves to be considered are propagated in much the same way as light. The field at a receiving antenna is the result of the combination of a direct and one or more reflected rays. In the simplest case, there is only one reflected ray from the ground (see Figure 1). The resulting field strength depends upon the relative phase and amplitude of the two components. The phase relation is determined by the path-length difference between the two rays and the phase shift occurring at the reflection point. The relative amplitudes are determined by the absolute value of the reflection coefficient, whereas the absolute amplitudes are determined by the radiated power in the direction considered.

These statements are more concisely given by

$$E=E_o+E_o k\epsilon^{j(\theta+\psi)}=E_o(1+k\epsilon^{j(\theta+\psi)}) \tag{1}$$

where

E is the resultant field
E_o is the free-space or direct-ray field
$k\epsilon^{j\theta}$ is the ground reflection coefficient
θ is the phase shift at the reflection point
ψ is the phase shift between the direct and reflected rays due to path-length difference

It can be shown that the free-space field from a half-wave dipole is

$$E_o=(7\sqrt{w})/r \text{ volts per meter} \tag{2}$$

for a distance r in meters and a radiated power w in watts.

It has been shown elsewhere[7] that the coefficient of reflection $k\epsilon^{j\theta}$ from a plane surface is given by the following expressions. For horizontally polarized waves

$$k_h\epsilon^{j\theta}=\frac{\sin\phi-\sqrt{\epsilon_o-1+\sin^2\phi}}{\sin\phi+\sqrt{\epsilon_o-1+\sin^2\phi}} \tag{3}$$

and for vertically polarized waves

$$k_v\epsilon^{j\theta}=\frac{\epsilon_o\sin\phi-\sqrt{\epsilon_o-1+\sin^2\phi}}{\epsilon_o\sin\phi+\sqrt{\epsilon_o-1+\sin^2\phi}} \tag{4}$$

where

$$\epsilon_o=\epsilon_r-j1.8\times10^{10}g/f \tag{5}$$

ϵ_r = relative dielectric constant of the reflecting plane
g = conductivity of the reflecting plane in mhos per meter
f = frequency
ϕ = the angle between the reflected ray and the reflecting plane

The quantity ϵ_o may be considered the complex dielectric constant taking into account the phase angle introduced by the conductivity of the medium.

The phase shift of the reflected ray due to path length difference can be shown to be

$$\psi=-(4\pi ha)/\lambda r \tag{6}$$

when r is large compared with $a+h$, where h and a are the transmitting and receiving antenna heights and λ the wave length.

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We now have all of the quantities necessary for the calculation of field intensities over line of sight paths. There is a marked difference between the reflection coefficients of equations 3 and 4, when the medium is dielectric. For vertically polarized waves the reflected ray at grazing incidence has the same amplitude before and after reflection. As the angle ϕ is increased, the coefficient of reflection becomes smaller, while the phase shift θ remains constant at 180 degrees. When ϕ reaches the angle whose cotangent is equal to $\sqrt{\epsilon_r}$, the reflected ray disappears, and a further increase in

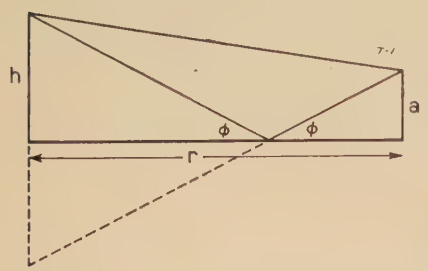

Figure 1. Diagram showing paths of the direct and a single reflected ray

Antenna heights above ground are h and a

ϕ gives a sharply increasing reflected ray with a constant phase shift of zero degrees. For horizontally polarized waves reflecting from a dielectric medium, the phase of the reflected ray remains at 180 degrees, and the amplitude continually drops with increasing ϕ.

Over land paths, it is necessary to plot an actual profile of the circuit to determine the net heights of the transmitting and receiving antennas above the reflecting plane. Normal atmospheric refraction causes a bending of the waves downward, giving a little improvement over an unrefracting atmosphere. This effect is usually taken care of by plotting the profile with 4/3 earth radius in place of unity.

Quite often atmospheric conditions are encountered in which rather sharp discontinuities reflect or refract the waves back to earth, thereby giving increased field intensities at distant points and beyond the horizon. These conditions are more prevalent during the warmer parts of the year.

It is obvious that equation 1 does not take into account diffraction and scattering effects which are always present and become important as the angle ϕ approaches zero.

Equation 1 can be simplified into the approximate equation

$$E = E_o(4\pi ha)/\lambda r = (28\pi\sqrt{wha})/r^2\lambda \text{ volts per meter} \tag{7}$$

for propagation over average ground. The approximation is satisfactory for small values of the angle $(4\pi ha)/\lambda r$ where the sine of the angle and the angle can be considered equal. The approximation is unsatisfactory at grazing incidence where this angle is zero, since diffraction and scattering usually give a field 10 to 30 decibels below the free-space value at grazing incidence.

Let us assume a radio circuit having constant values of r and w with a half-wave dipole antenna at the transmitter and receiver. We are interested primarily in the power delivered to the receiver. Under matched conditions this power is $\left(\frac{E\lambda}{2\pi}\right)^2\frac{1}{75}$ since the effective length of the dipole is λ/π, or $w_r = E^2\lambda^2/300\pi^2$ watts (8)

Substituting equation 7 for E^2 gives

$$w_r = (2.6wh^2a^2)/r^4 \tag{9}$$

The received power is seen to be independent of λ so long as we use half-wave dipole antennas at suitable heights above ground to satisfy the approximate equation 7. As the wave length is lowered, the field intensity increases linearly while the effective length of the receiving antenna decreases at the same rate.

If we assume the two antenna heights to be equal, then the received power varies as the fourth power of this height, and this shows the importance of keeping the antennas at a good elevation above ground.

In the ultrashort-wave range, it is very convenient to use directive antennas. Physical considerations usually limit the size of such antennas, and so we will consider one having a constant aperture of S square meters. A field E in free space represents a power of $E^2/120\pi$ watts per square meter. An antenna of aperture S will be capable of absorbing a power of $SE^2/120\pi$ watts. The power gain over a half-wave doublet is then

$$G = \frac{\dfrac{SE^2}{120\pi}}{\dfrac{E^2\lambda^2}{300\pi^2}} = 2.5\pi S/\lambda^2 \tag{10}$$

With antennas of aperture S at each end of the circuit, the received power from equation 9 becomes

$$w_r = \frac{2.6wh^2a^2}{r^4}G^2 = 16.2\pi^2 wS^2\frac{h^2a^2}{r^4\lambda^4} \tag{11}$$

By putting $h = a$, we get $w_r = 16.2\pi^2 wS^2(h/r\lambda)^4$ (12)

Equation 12 shows that the received power is proportional to the fourth power of the antenna heights, as well as inversely proportional to the fourth power of the wave length. With fixed-aperture antennas, there is a considerable advantage in going to higher frequencies if the transmitter power w can be maintained constant. It should be noted that constant power is delivered to a receiver by a fixed-aperture antenna in the presence of a constant field intensity, regardless of frequency. This is true even though the power gain of the antenna increases with the square of the frequency, giving a correspondingly narrower directive pattern. It should be remembered that the power gain here used is referred to a half-wave dipole whose effective length is proportional to wave length. The gain in received power with increasing frequency comes about from the increased power radiated in the direction of the receiver by the transmitting antenna directivity, and by virtue of the greater phase delay of the reflected ray causing less cancellation with the direct ray.

Ordinary considerations require the transmitting and receiving antennas to be as high as possible above the intervening terrain. With rather short wave lengths, the phase delay of the reflected ray can reach large values with only moderate heights. Increasing the antenna elevations eventually will bring the reflected and direct rays in phase; at which time maximum signal will be obtained. Further elevation gives a decreasing field until the two components are in phase opposition. Thus the antenna heights must be neither too high nor too low for best results.

SIGNAL-TO-NOISE RATIO

Reception problems in the ultrahigh-frequency range are similar to those in the lower-frequency bands. Since atmospheric disturbances are usually so small as to be neglected, our attention is directed toward obtaining a receiver having as low an internal noise level as possible. Figure 2a shows a receiver input where e represents the induced antenna signal voltage, R_a the antenna radiation resistance, m the step-up voltage ratio of an ideal transformer having no loss or leakage reactance, and R_b a loading to take account of antenna feed-line loss, and transformer inefficiency. Since we are neglecting atmospheric noises, we will substitute a signal generator at room temperature to take the place of R_a and e. With an ideal vacuum tube the thermal agitation noise of resistors R_a and R_b (e_{ta} and e_{tb}, respectively) will supply the only noise appearing at the grid. The ideal vacuum tube will have no electronic input loading and no plate shot noise. Figure 2a and 2b are equivalent diagrams. Thermal noise induced voltage takes the form

$$e_t^2 = 4kT\Delta f R \tag{13}$$

where k is Boltzman's constant (1.37×10^{-23} joules per degree Kelvin), T the ambient temperature in degrees Kelvin, and Δf the over-all effective pass band in question. Then the signal-to-noise ratio at the grid is:

$$S/N = \frac{me\dfrac{R_b}{m^2R_a+R_b}}{\sqrt{4kT\Delta f\dfrac{m^2R_aR_b}{m^2R_a+R_b}}} = \frac{eR_b}{\sqrt{4kT\Delta f R_aR_b(m^2R_a+R_b)}} \tag{14}$$

since the effective resistance at the grid is $m^2R_aR_b \div m^2R_a+R_b$ for noise purposes. As the losses in the input circuits are reduced, R_b becomes very large, making

$$S/N \rightarrow \frac{e}{\sqrt{4kT\Delta f R_a}} \tag{15}$$

Under matched conditions $m^2R_a = R_b$, giving

$$S/N = \frac{1}{\sqrt{2}} \times \frac{e}{\sqrt{4kT\Delta f R_a}} \tag{16}$$

which is poorer by the factor $\sqrt{2}$.

Equation 15 shows the performance of an ideal receiver in which the only noise is the thermal agitation noise of the signal source. This optimum value cannot be realized in practice, since there are other noise sources such as

1. Induced input electrode noise in the first tube.
2. Plate shot noise of the first and subsequent tubes referred to the input circuit.

North and Ferris[8] have found the induced grid noise, for tubes with an input control grid adjacent to the oxide-coated cathode, to be equivalent to the thermal noise of a resistor equal to the electronic loading whose temperature is about five times room temperature.

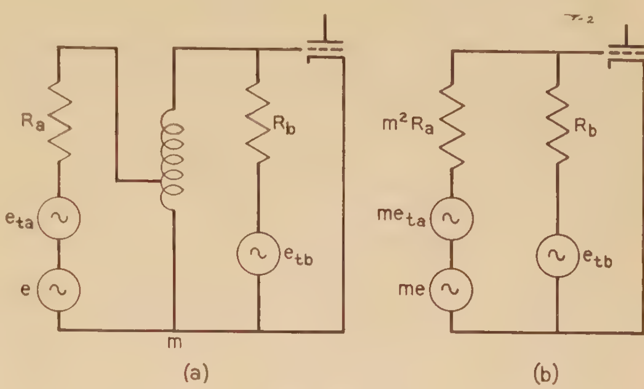

Figure 2

(a). Schematic diagram of receiver input circuit using an ideal vacuum tube

(b). Diagram equivalent to (a) with unity transformation ratio

A high-frequency receiver of good design will have an efficient input transformer, so that the resistor R_b will represent mainly the electronic loading of the input electrode.[3] The generator e_{tb} will then take the form

$$e_{tb} = \sqrt{20kTR_b\Delta f} \tag{17}$$

and equation 14 then becomes

$$S/N = \frac{eR_b}{\sqrt{4kT\Delta f R_aR_b(5m^2R_a+R_b)}} \tag{18}$$

Here the plate shot noise of the first and subsequent tubes has been neglected for simplicity. For this reason it will be seen that, as we make R_b large compared with $5m^2R_a$, the signal-to-noise ratio approaches the ideal value, as shown in equation 15. For a given frequency, the electronic loading R_b is fixed, and so we are tempted to reduce $5m^2R_a$ by reducing m to accomplish the same thing. We soon get into trouble doing this, since a very small value of m provides vanishingly small values of signal and thermal agitation noise at the first grid, leaving nothing but plate shot noise in the receiver output with a very poor signal-to-noise ratio.

In Figure 3 a new noise generator e_{eq} has been inserted in series with the grid to take care of all noises generated

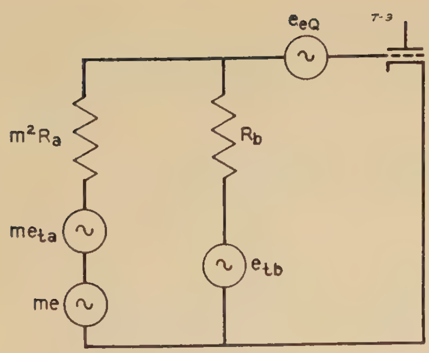

Figure 3. Schematic diagram of receiver input circuit using an actual vacuum tube

subsequent to this electrode in the receiver. This generator may be assumed to take the form

$$e_{eq} = \sqrt{4kT\Delta f R_{eq}} \tag{19}$$

where R_{eq} is the resistance whose terminal agitation noise at the first grid would supply all of the plate shot noise present in the receiver. The signal-to-noise ratio may now be expressed

$$S/N = \frac{eR_b}{\sqrt{4kT\Delta f\left[R_aR_b(5m^2R_a+R_b)+\frac{R_{eq}}{m^2}(m^2R_a+R_b)^2\right]}} \tag{20}$$

Maximizing the expression of equation 20 with respect to m gives

$$m^2 = \frac{R_b}{R_a}\sqrt{\frac{R_{eq}}{R_{eq}+5R_b}} \tag{21}$$

The matched condition corresponds with $m^2 = R_b/R_a$, so that the best signal-to-noise ratio is obtained by making m^2 smaller than the matched value by the factor $\sqrt{R_{eq}/(R_{eq}+5R_b)}$. Thus, if R_{eq} and R_b happen to have about the same values, the impedance step-up of the input transformer should be smaller than the matched condition by a factor of about $\sqrt{1/6}$ in order to achieve best operating conditions. The possible improvement in signal-to-noise ratio over the matched condition will usually be found to be quite small, particularly at the higher frequencies where the electronic loading resistance R_b becomes smaller. In fact, R_b is inversely proportional to the frequency squared for a given tube type.

Since the matched condition gives nearly the best performance in many cases, we can put $m^2 = R_b/R_a$ in equation 20 to give

$$S/N \text{ matched} = \frac{e}{\sqrt{4kT\Delta f\left(6+4\frac{R_{eq}}{R_b}\right)R_a}} \tag{22}$$

Comparing this with equation 16 (the best matched condition) shows the result to be poorer by the factor $\sqrt{1/\left(3+2\frac{R_{eq}}{R_b}\right)}$. Obviously the best S/N ratio will be obtained by making R_{eq} as small as possible and R_b as large as possible, which is, of course, a problem in vacuum-tube design. In addition to this, the receiver input circuits must be made efficient to avoid any unnecessary loss of signal energy there.

Equation 22 express a voltage ratio. By squaring both sides we get the signal-to-noise power ratio which may be expressed as

$$\frac{w_r}{w_n} = \frac{e^2}{4kT\Delta f\left(6+4\frac{R_{eq}}{R_b}\right)R_a} \tag{23}$$

where w_r is the received power referred to under "Propagation," and w_n may be called the noise power input to the receiver referred to the input terminals. From Figure 3 under matched conditions w_r becomes $e^2/4R_a$. Putting this in equation 23 gives

$$w_n = kT\Delta f\left(6+4\frac{R_{eq}}{R_b}\right) \tag{24}$$

Equation 15 shows we cannot improve the signal-to-noise ratio beyond the ideal case where thermal agitation of the signal source supplies all of the noise present in the receiver output. Since all receivers will give poorer results, it is convenient to express the performance of an actual receiver in the following way:

$$\text{Actual measured } S/N = \frac{e}{\sqrt{4kT\Delta f R_a N_e}} \tag{25}$$

where N_e is a dimensionless factor sometimes called the excess-noise ratio. Thus the ratio

$$\frac{S/N \text{ ideal}}{S/N \text{ measured}} = \sqrt{N_e} \tag{26}$$

or

$$\frac{w_n \text{ measured}}{w_n \text{ ideal}} = N_e \tag{27}$$

N_e is then a measure of the excess of the measured noise power over the purely fictitious ideal noise power and is usually expressed in decibels. In the ideal case, there is no power input to the receiver terminals, and so N_e may be considered the ratio of the measured to the ideal-noise powers at the receiver output. These powers then can be referred arbitrarily to the input terminals, as a voltage across any specified resistance.

From equation 22, under matched conditions, the excess-noise ratio is seen to be

$$N_e = 6+4\frac{R_{eq}}{R_b} \tag{28}$$

This equation is valid only when there is no energy-transfer loss from the antenna to the first grid, and when the electronic loading R_b can be considered as a noise generator of the form, $e_{tb} = \sqrt{20kT\Delta f R_b}$.

The concept of using the term, excess-noise ratio, is very convenient, since it completely specifies receiver performance and does not require the specification of band width, receiver input impedance, signal generator impedance, or frequency.

The effective band width Δf, for noise purposes, is the

width of a hypothetical "rectangular" band-pass filter which would pass the same mean-square value of noise current or voltage, with the same transfer ratio at reference frequency (usually mid-band). It is therefore obtained from a plot of the squared response versus frequency curve on linear co-ordinates as follows:

$$\Delta f = \frac{\text{Area under squared response curve in square centimeters}}{\text{Reference frequency squared response in centimeters}} \times \text{abscissa } \frac{\text{cycles per second}}{\text{centimeter}}$$

Going back to the term R_{eq} which was introduced to take care of all noise generated subsequent to the first grid in the receiver, we see that very low stage gains tend to give rather high values of R_{eq}. The reason for this is that plate shot noise from the second and following stages begins to appear in the receiver output. Usually a voltage gain of only two or three per stage is sufficient to avoid this condition.

For a single parallel resonant circuit with tuning capacitance C and shunt resistor R, it can be shown that $RC\Delta f$ is approximately a constant and is independent of the resonant frequency. This relation is also approximately correct (with a slightly different value of the constant) for band-pass filter sections where C is the shunt capacitance and R the terminating impedance. Increasing the value of Δf therefore requires the proportionate reduction of RC. Since the minimum value of C is fixed by tube electrode capacitances, we are forced to reduce R for very wide bands, giving decreasing values of plate load impedances. This gives rise to lower stage gains, since in most cases the gain is proportional to R. This in turn can give higher values of R_{eq} and consequently, poorer noise performance.

In the expressions for signal-to-noise ratio, the factor Δf (over-all effective band width) always appears, since thermal agitation and shot-noise power are proportional to Δf. In the simplest type of receiver the band width is determined by the width of the intermediate frequency amplifier, assuming the circuits after detection are capable of passing the highest rectified side band components. In the ultrahigh-frequency field it is quite common to use a much wider intermediate-frequency amplifier than is required to carry the highest side band components. In this case the circuits after detection determine the over-all band passed for noise purposes, only if there is present a signal carrier having a peak amplitude greater than the peak amplitude of the noise before final detection. Under this condition the noise components may be considered as side bands of the carrier. Thus the circuits after detection accept a radio-frequency band of twice their own band width. If the carrier is not present, noise components beat with each other throughout the whole intermediate-frequency band giving a higher detected noise output. This type of receiver may be said to have a threshold signal level (peak carrier = peak noise) below which the equivalent band width rapidly widens, giving a correspondingly poorer signal-to-noise ratio. Signal measurements with such a receiver should be made with carrier levels above the threshold in order that the factor Δf can be stated concisely.

As contrasted with random noise, we often have to deal with impulse disturbances of which motorcar ignition is the most common source. Here the peak-voltage amplitude of the noise is proportional to the band width, in which the measurement is made, if the band width is sufficient not to cause overlapping of the impulses. With increasing frequency we might expect ignition interference to be less troublesome, because of the poorer efficiency of the spark transmitter. However, measurements[9] show the peak field intensity per cycle of band width to be reasonably constant over the frequency range 40 to 450 megacycles per second. This fact might be explained by improved propagation conditions at higher frequencies as mentioned earlier under "Propagation."

In conclusion, the main problems in reception are to take advantage of propagation phenomena in order to give as strong a signal as possible at the receiver, and to provide a receiver with an excess-noise ratio as small as possible in order to make best use of the signal. The excess-noise ratio is simply a measure of the receiver performance compared with an ideal condition wherein the thermal agitation level of the signal source supplies all of the noise present in the receiver output.

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Conductor Redesign Saves Copper

A. A. OSIPOVICH

Wartime contingencies determined the redesign of a major high-voltage transmission line to save 985 tons of newly mined copper for other war purposes. The result is a segmental line carrying five different types of expanded aluminum and copper conductors.

DESIGNING an important high-voltage transmission line is an engineering assignment of major proportions even during so-called "normal times." Under present war conditions such an assignment becomes vastly more complicated. Customary materials are no longer obtainable through normal peacetime supply channels; nor are suitable equipment and qualified manpower readily available for the orderly prosecution of the work.

An 83-mile 230-kv transmission line, recently completed and placed in operation in the Pacific North West, transmits power generated at one of the large governmental hydroelectric plants to an important industrial area. The line originally was designed as a conventional double-circuit steel-tower system. It had been located and surveyed to accommodate this type of structure. Because of scarcity of aluminum, the design was based on the use of copper conductors. Load and economy studies led to the use of an expanded-type standard-strength conductor having a minimum outside diameter of 1.08 inches and a copper equivalent area of 500,000 circular mils. Sag–tension characteristics were determined for such conductors, and the steel towers were designed to provide factors of safety, under the National Electric Safety Code, adequate for "Heavy Loading" and the type of country traversed by the line. After these basic design conditions had been determined, the line was sagged-in, and towers were selected as to height, type, and leg extension for each tower location. A contract for their fabrication was awarded, and actual production was started in accordance with established construction and energization schedules. Similarly, conductor specifications had been issued, bids opened, and the *H-H* segmental type of conductor purchased for the full length of the double-circuit line (186 circuit-miles).

Just then the War Production Board decided that, because of great scarcity of newly mined copper, only one circuit of the projected line should be built. Shortly thereafter the board recognized the urgent need for building both 230-kv circuits. Their construction was authorized, however, only on the condition that all expanded 500,000-circular-mil conductors, of whatever type and make, that could be found in unassigned stocks be diverted to use on this line. This was necessary in order that requirements of new copper for fabrication of the *H-H* conductor be reduced to an absolute minimum. Of such conductors, limited quantities of four types were on hand, each type differing from the other in basic material, make, and strength.

As the line and its structures were designed only for standard-strength conductors, the ruling of the War Production Board immediately created a "jigsaw puzzle" type of problem. Time and conditions did not permit resagging the line to suit the most economical characteristics of the conductors found in stock. Nor was it possible to change the strength characteristics of the towers, then in fabrication, to accommodate the higher-strength conductors. Rather, it became necessary to establish such sag–tension relationships for each individual conductor (Table II) as to make it fit, in so far as possible, into the most suitable section of the line considering the structures previously selected, without jeopardizing unduly the originally established factors of safety.

In solving this problem, careful consideration had to be given to the area near the power plant, as fogs have been known to precipitate heavy ice and sleet formations in the area during winter months. It was necessary, therefore, to place the strongest conductors in that area and to grade the line with regard to conductor strength

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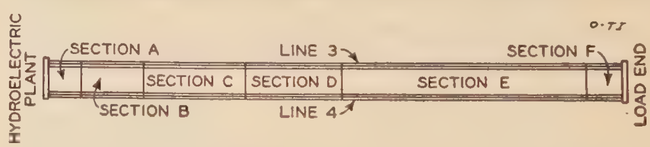
Table I. Data for Conductors Used, by Sections



Section	Conductor	Location	Right-of-Way Miles	Conductors: Feet Required	Conductors: Pounds Required
A	Alcoa Mallard*	Hydroelectric plant to Tower 22	3.82	123,770	152,732
B	*PDCP* 1251-*CHSC***	Tower 22 to Tower 59	6.98	226,150	441,174
C	Alcoa Drake†	Tower 59 to Tower 128	13.63	441,600	482,669
D	Anaconda 892-*R*3	Tower 128 to Tower 176	9.56	309,750	484,759
E	General Cable *H-H*	Tower 176 to Tower 401	45.03	1,459,000	2,229,352
F	*PDCP* 1251-*CHSC*	Tower 401 to Load end	3.75	121,500	237,022

Copper requirement for new conductor as originally ordered .... 2,100 tons
New copper conductor actually ordered .... 1,115 tons
Saving of copper .... 985 tons

* Aluminum Company of America steel-reinforced aluminum Mallard conductor.

** Phelps Dodge Copper Products copper and steel-clad copper conductor.

† Aluminum Company of America steel-reinforced aluminum Drake conductor.

in the direction from the plant to the load end of the line.

Another problem encountered was that of the location of dead-end and transposition towers. In the original design these locations were selected carefully with a view to sectionalizing the line properly for purposes of conductor sagging and to fit the selected transposition scheme. Foundations were designed and steel was ordered in accordance with the nature of the selected locations. In consequence, the points where changes from one type of conductor to another could be made were to a great extent fixed by the original design of the line. In order that maintenance and operation difficulties resulting from so many different conductors in use on the line be reduced to a minimum, it also was decided to install the same type of conductor in both circuits of every section.

A number of trial combinations was necessary before the final plan was selected. According to this plan, five different conductors (Figure 1) illustrated diagrammatically in Table I, are arranged into six sections. The higher-strength aluminum and copper conductors are placed in three sections nearest the plant; these comprise a total of $24^1/_2$ miles. Standard-strength conductors are arranged in the next two sections having a total length of $54^1/_2$ miles. The $3^3/_4$-mile section nearest the load end utilizes one of the high-strength conductors primarily to use up its available stock and because in this locality the line crosses several major highways.

For all practical purposes, the transposition scheme for the entire line was left as it was originally designed to meet the proper co-ordination requirements. Only two minor changes in line design were necessary. These changes were dictated by the length of the available expanded conductors and the necessity of providing termination points for them. Consequently, design locations of one dead-end tower and one transposition tower had to be interchanged with those of two suspension towers. Simple adjustments in footing design were all that was required to accomplish this shuffle. The final positions of all the towers involved were within a half-mile from their original stations.

In such a manner, the objective of reducing to a minimum the use of new copper, critically needed for other war purposes, was attained through a fairly simple redesign which left the line in no wise disturbed as to its originally laid-out mechanical strength or transposition scheme. New copper was required only for the 90 circuit-miles of the *H-H*-type conductor, instead of the total double-circuit length of the entire line. A saving of approximately 985 tons of newly mined copper was effected, and an important ruling of the War Production Board was fulfilled successfully.

In its present redesigned condition, this line is unique among similar high-voltage transmission lines. It offers excellent opportunities for observation and study of the behavior of its five different types of expanded conductors under as nearly similar conditions as could ever be expected in an installation designed not for experimental but for practical purposes.

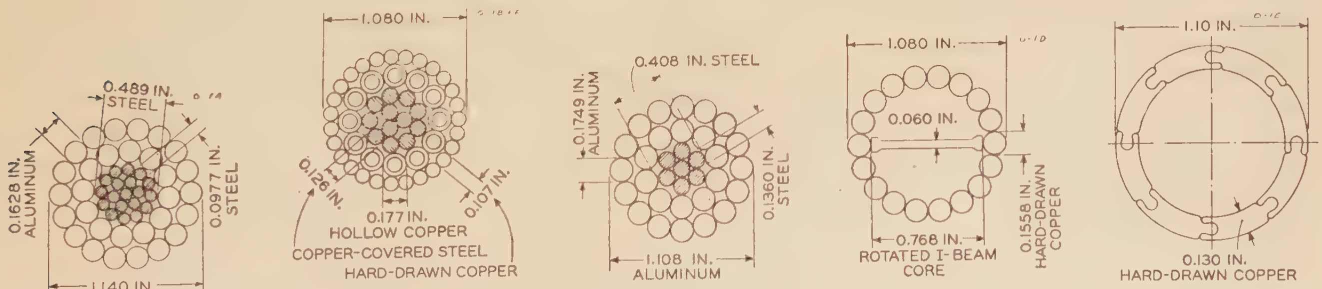
Like so many storm clouds having their silver linings, so, it seems, the war-dictated redesign of the line may prove to be of tangible value in contributing ultimately reliable data for the furthering of modern trends in the design of high-voltage transmission conductors.

Table II. Comparative Data for Conductors Used, Design Conditions

Original—Maximum Working Tension of 10,000 Pounds at One-Half Inch Radial Ice, Eight Pounds Wind and Zero Degrees Fahrenheit (NESC Standard Heavy Loading) for Standard-Strength Expanded 500,000-Circular-Mil Copper Conductor (Minimum Outside Diameter = 1.08 Inches)

Final—Same as Above, Except That Maximum Working Tension to 11,400 Pounds Was Adopted in the Case of Phelps Dodge Conductor of Obtain Approximately Same Sags as for Standard Conductors

	Conductors				
	Section A	Sections B and F	Section C	Section D	Section E
Total area, circular mils	795,000	637,280	795,000	500,300	500,000
Ultimate rated strength pounds	38,400	40,000	31,200	21,250	22,400
Outside diameter, inches	1.140	1.080	1.108	1.080	1.100
Maximum sag for 1,000-ft level span at $^1/_2$-inch ice, 0 pounds wind, 32 F	34 36	36.64	32.39	37.32	36.83
Tension for above	8,309	10,128	2,176	8,688	8,646
Maximum sag for 1,000-ft level span, 0 pounds wind, 120 F	36.38	38.15	34.42	38.47	36.23
Tension for above	4,292	6,436	4,013	5,155	5,064



A—Steel-reinforced aluminum Mallard conductor used in section A

B—Copper and steel-clad copper conductor used in sections B and F

C—Steel-reinforced aluminum Drake conductor used in section C

D—Hollow copper conductor with rotated I-beam core used in section D

E—Segmental-type hollow copper conductor used in section E

Figure 1. Conductor cross sections

INSTITUTE ACTIVITIES

AIEE Board of Directors Meets

The regular meeting of the board of directors of the American Institute of Electrical Engineers was held at Institute headquarters, New York, August 4, 1943.

Minutes were approved of the meeting of the board of directors held June 24, 1943.

Recommendations adopted by the board of examiners July 22, 1943, on applications for election, transfer, and Student enrollment were reported and approved. The following actions were taken on recommendation of the board of examiners: 13 applicants were transferred to the grade of Fellow; 71 applicants were transferred and 36 were elected to the grade of Member; 227 applicants were elected to the grade of Associate; 58 Students were enrolled.

The special committee on pension plans submitted in final form a proposed plan for a retirement system for AIEE employees, which had been prepared by the committee, with the aid of a consulting actuary, by direction of the board of directors. The board adopted the plan and, in accordance with its provisions, appointed as two of the three members of the board of trustees to administer the system, H. S. Osborne (member of the board of directors), and H. H. Barnes, Jr. (Fellow of the Institute, not a member of the board), the third member to be an AIEE employee. The special committee was discharged, with an expression of the board's appreciation of its work.

July disbursements amounting to $32,247.33 were reported by the finance committee and approved by the board.

At its June meeting, the board of directors took action transferring all of North Dakota and all of South Dakota except the western part which is in the Denver Section from the North Central District (number 6) to the Great Lakes District (number 5), making necessary a readjustment of Section territories, as all of the territory affected was included in the Nebraska Section (in District 6). Upon recommendation of the officers of the Nebraska Section and the vice-president of District 6, and the Sections Committee, the board voted to transfer the territory in question from the Nebraska Section to the Minnesota Section.

The appointment by the president of the general and technical committees of the Institute for the administrative year beginning August 1, 1943, was announced.

The board confirmed the following appointments made by the president, as required by the by laws of the respective committees:

Charles LeGeyt Fortescue Fellowship Committee—A. R. Stevenson, Jr., and H. W. Tenney *members* for the three-year term beginning August 1, 1943, and J. M. Gaylord to serve for the unexpired term ending July 31, 1944, of D. F. Niner, resigned.

Lamme Medal Committee—Robin Beach, O. B. Blackwell, and C. M. Laffoon *members* for the three-year term beginning August 1, 1943.

Edison Medal Committee—Carl R. Freehafer, C. A. Powel, and David Sarnoff *members* for the five-year term beginning August 1, 1943, and A. E. Knowlton to serve for the unexpired term ending July 31, 1944, of L. W. W. Morrow, deceased; also W. B. Kouwenhoven *chairman* for the year 1943–44; W. J. Gilson, C. M. Laffoon, and W. Ralph Smith from the board of directors, *members* for the two-year term beginning August 1, 1942.

Section 80 of the bylaws requires that the committee on award of Institute prizes shall consist of the chairmen of certain committees, and of such other committees as the board of directors may designate. The board directed that the chairmen of the communication, electrical machinery, power transmission and distribution, and protective devices committees be appointed as additional members of the committee for the year beginning August 1, 1943.

Representatives of the Institute on other bodies were appointed for the year beginning August 1, 1943. (See list of representatives elsewhere in this issue.) Other representatives appointed were:

Everett S. Lee to the Engineers' Council for Professional Development for the three-year term beginning in October 1943.

G. L. Knight reappointed to the library board of the United Engineering Trustees, Inc., for the four-year term beginning in October 1943.

C. E. Stephens reappointed to the board of trustees of the United Engineering Trustees, Inc., for the four-year term beginning in October 1943.

W. A. Lewis to the research procedure committee of The Engineering Foundation for the one-year term beginning October 1, 1943.

R. T. Henry reappointed a representative on the Standards Council of the American Standards Association for the three-year term beginning January 1, 1944.

H. E. Farrer, H. L. Huber, and E. B. Paxton reappointed alternates on the Standards Council for the calendar year 1944.

Local honorary secretaries of the Institute were reappointed for the two-year term beginning August 1, 1943, as follows:

R. H. Bowles for Brazil.
A. F. Enstrom for Sweden.
A. P. M. Fleming for England.
P. H. Powell for New Zealand.

Those present were:

President—Nevin E. Funk, Philadelphia, Pa.

Past Presidents—H. S. Osborne, New York, N. Y.; David C. Prince, Schenectady, N. Y.

Vice-Presidents—L. A. Bingham, Lincoln, Nebr.; A. G. Dewars, Minneapolis, Minn.; Charles R. Jones, New York, N. Y.; C. W. Ricker, New Orleans, La.; W. E. Wickenden, Cleveland, Ohio.

Directors—T. F. Barton, New York, N. Y.; M. S. Coover, Ames, Iowa; K. L. Hansen, Milwaukee, Wis.; C. M. Laffoon, East Pittsburgh, Pa.; T. G. LeClair, Chicago, Ill.; S. H. Mortensen, Milwaukee, Wis.; W. B. Morton, Philadelphia, Pa.; W. Ralph Smith, Newark, N. J.; R. G. Warner, New Haven, Conn.

National Treasurer—W. I. Slichter, Schenectady, N. Y.

National Secretary—H. H. Henline, New York, N. Y.

Series on Ultrashort Waves to Be Issued as Pamphlet

The series of articles currently being published in *Electrical Engineering* on "Ultrashort Electromagnetic Waves," of which the concluding article appears in this issue, is being reprinted in pamphlet form in response to numerous requests. The six articles were presented initially as lectures before the basic science group of the AIEE New York Section in Pupin Hall, Columbia University, during the winter and spring of 1942–43. Professor Paul C. Cromwell of New York University was chairman of the lecture committee.

The articles as subsequently published in *Electrical Engineering* are:

I—Electromagnetic Theory, Ernst Weber, Polytechnic Institute of Brooklyn (*Mar. '43, pp. 103–12*).

II—Transmission Lines at Ultrahigh Frequencies, John R. Ragazzini, Columbia University (*Apr. '43, pp. 159–67*).

III—Generation, I. E. Mouromtseff, Westinghouse Electric and Manufacturing Company (*May '43, pp. 207–15*).

IV—Guided Propagation, S. A. Schelkunoff, Bell Telephone Laboratories, Inc. (*June '43, pp. 235–45*).

V—Radiation, Andrew Alford, Federal Telephone and Radio Corporation (*July '43, pp. 303–12; August '43, pp. 338–44*).

VI—Reception, Bertram Trevor, Radio Corporation of America Laboratories (*Sept. '43, pp. 405–09*).

The purpose of the lectures, which have been published in essentially the form in which they were delivered, was to present to engineers in a condensed and simplified form the fundamental theory of ultrashort electromagnetic waves. For those interested in studying the basic subject matter in more rigorous and complete form, lists of references accompany each article. In order to make the series available for use in a convenient form, a consolidated 64-page pamphlet reprint bound in a substantial cover is being issued. Copies may be obtained from the AIEE order department, 33 West 39th Street, New York 18, N. Y., at 50 cents each; a reduction of 20 per cent will be allowed on orders of ten or more copies to be sent to the same address at the same time. Remittances, payable in New York exchange, should accompany orders, which will be filled as soon as the reprint pamphlets become available.

Future AIEE Meetings

National Technical Meeting
Salt Lake City, Utah, September 2–4, 1943

Southern District Meeting
Roanoke, Va., November 16–18, 1943

National Technical Meeting
New York, N. Y., January 24–28, 1944

AIEE Wartime Engineering Activities Outlined

In line with the AIEE wartime policies, formulated by the committee on planning and co-ordination and adopted by the board of directors August 7, 1942 (*EE, Sept. '42, p. 477*), the AIEE committees have been engaged actively in many activities concerned directly with the war effort. In order that the membership as a whole may know more about the Institute's contribution to the conduct of the war, this chart of wartime engineering activities has been prepared.

This chart, which shows how AIEE has been carrying on its wartime polciy, aims to present an authoritative picture of wartime engineering activities of the Institute and lists some of the most important of these, grouped according to their committee sponsorship.

Most of these activities have been carried on at the direct request of military authorities and other governmental agencies. Some have had to do with the procurement and allocation of engineering man power and technical specialists, some with the engineering educational program, and some with the conservation of critical materials. Some of the work has been completed, whereas other projects are still actively in progress. A partial survey of wartime projects is indicated in the references at the bottom of the chart to news articles published in *Electrical Engineering* during the past year.

AIEE Board of Directors

Headquarters Staff

Committee on Co-operation With War Agencies[1]

- *Procurement of technical specialists for armed services
- Consultative committee on engineering—War Manpower Commission
- **National Technological Civil Protection Committee
- Studies of conservation of materials[2]
- Assistance in formulation of reference library for United States Signal Corps[3]
- Study of use of silver as a substitute for copper and aluminum in electrical installations[6]

Headquarters Staff

- Studies of supply and demand of engineers[4]
- National Roster of Scientific and Specialized Personnel[5]
- Selection of co-ordinators for defense contracts services
- National census of engineering firms

Planning and Co-ordination Committee

- General Planning and guidance concerning wartime problems[6]
- **Engineering co-operation with South American countries[7]
- **Engineers Defense Board (terminated in 1942)

Standards Committee

- Wartime emergency standards[8]
- Wartime guides and reports for application and operation of electrical apparatus[9]
- Electrical apparatus standards[10]
- Special standardizing projects[11]

Technical Program Committee

- National technical meetings[12]
- District technical meetings[13]
- Special programs devoted to wartime subjects[14]

Sections Committee and Sections

- *Procurement of technical specialists for armed services
- Conservation of critical materials[15]
- Information on engineering firms and individuals available for war work
- Clinics relating to methods of improving production in war plants[16]

Various Technical Committees

- ♯Preparation of Standards, guides; reports, pertaining to war effort[17]
- Acceleration of regular engineering programs in colleges[18]
- Aid in providing research facilities and man power

Government Agencies Requesting Assistance on War Projects

Joint Army–Navy Officer Procurement
Corps of Engineers
Signal Corps
Marine Corps
War Production Board
Office of Civilian Defense
United States Office of Education
Provost Marshall General

*Several committees collaborated in this activity.

**Joint organization with other societies.

♯Apparatus Standards, wartime guides, reports on Standards, generally prepared by technical committees, then submitted to the Standards committee for consideration and approval.

1. *Mar. '43, p. 119.*
2. *Jan. '43, p. 41; Apr. '43, p. 181.*
3. *Sept. '42, p. 476.*
4. *Sept. '42, p. 492; Oct. '42, pp. 540, 541; Nov. '42, p. 583; Dec. '42, p. 634; Jan. '43, p. 40; Feb. '43, pp. 81, 82; Mar. '43, p. 136; Apr. '43, p. 185; May '43, p. 223; June '43, p. 277; July '43, p. 322.*
5. *May '43, p. 224.*
6. *Apr. '43, p. 182.*
7. *Aug. '43, pp. 369, 370.*
8. *June '43, p. 266.*
9. *June '43, p. 258; Aug. '43, p. 361.*
10. *June '43, p. 258.*
11. *Mar. '43, p. 114.*
12. *Dec. '42, p. 616; Jan. '43, p. 25; Mar. '43, p. 115; June '43, p. 255; Aug. '43, p. 359.*
13. *Mar. '43, p. 113; May '43, p. 216; June '43, p. 259.*
14. *June '43, p. 255.*
15. *Oct. '42, p. 527.*
16. *Apr. '43, p. 171; May '43, p. 218; June '43, pp. 265, 277.*
17. *Mar. '43, pp. 123, 125; Aug. '43, p. 375.*
18. *Mar. '43, p. 122; Aug. '43, pp. 372, 373.*

Lamme Medal Nominations

Attention is called again to the opportunity open to any Institute member to submit nominations for the 1943 AIEE Lamme Medal. All nominations must be received not later than December 1. For further particulars see *Electrical Engineering*, une 1943, page 266.

The 1942 medal was awarded to Joseph Slepian, associate director of research, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa. Addresses delivered at the presentation ceremonies are published in this issue of *Electrical Engineering*, pages 400–04.

SECTION • • • • •

Washington Section Holds Third Annual Outing

Incoming officers were installed and living past chairmen were honored at the third annual outing of the AIEE Washington Section on June 26, 1943, at Palisades Park, Washington, D. C.

Chairman for 1943–44 is A. G. Ennis (M '38) assistant professor of electrical engineering, George Washington University, Washington, D. C.

Presentation of Institute emblems to all past chairmen attending, including F. A. Wolff (M '34) chairman, 1903–04, and retiring chairman G. R. Wilhelm (M '42), was made by Doctor F. B. Silsbee (F '42). He also introduced R. W. Sorensen (F '19) past president of the Institute for 1940–41, who was a visitor to the Section. Special mention was made of the work of Mark Eldredge (F' 33) Institute director, in welcoming AIEE members new to Washington during the past year.

Games were played during the early evening, and a musical program, sponsored by the Telephone Glee Clubs, was presented after a picnic supper.

STANDARDS • • •

Rotating Electrical Machinery. On March 29, 1943 the American Standards Association approved a revised edition of the American Standard *C*50, "Rotating Electrical Machinery." The changes made in this edition, from the 1936 edition, recognize for the most part practices already in effect and to a lesser extent those newly developed. The types of machines covered are as follows: d-c rotating machines; synchronous generators, motors, and synchronous machines in general; synchronous converters; induction motors and machines in general; d-c and a-c fractional-horsepower motors. Copies of the pamphlet may be obtained from AIEE headquarters at $1.25 each, no discount to anyone.

A-C Power Circuit Breakers. A revised edition of AIEE Standard 19 was approved by the Institute May 27, 1943. This supersedes Standard 19, edition of 1938, entitled "Oil Circuit Breakers." The new standard includes the latest accepted data on dielectric tests, provisions for silver contacts, and so forth. Copies of the pamphlet may be obtained from AIEE headquarters at 40 cents each. Discount of 50 per cent to members of AIEE on single copies.

Co-ordination of AIEE and ASME Test Codes. At the June 22, 1943 meeting of the AIEE Standards committee, S. H. Mortensen gave a preliminary report for the Institute's committee on electrical machinery on the work now under way of co-ordinating the AIEE and American Society of Mechanical Engineers test codes, where similar subjects are covered. One of the principal things under consideration is the method of allocation of friction and windage losses for generator units.

Governor Specifications for 10,000-Kw Units. A. C. Monteith, chairman of the AIEE committee on power generation reported at the June 22, 1943 meeting of the Standards committee that his committee is developing governor specifications for 10,000-kw units and above. This material will come before the American Society of Mechanical Engineers in December and will probably be ready for action by the AIEE early in 1944. For further details see this issue, page 427.

Cable Terminal Potheads, Roof Bushings, and Floor and Wall Bushings. A proposal is now in course of development which will result in a revision of AIEE Standard 21, "Apparatus Bushings" (now an approved American Standard, *C*76.1). The revision will consist of additions to number 21 to cover roof, floor, and wall bushings. Official action by American Standards Association will be requested, revising the scope of the American Standard *C*76.1 (AIEE number 21) to include the new material. A separate standard for potheads will be developed.

Joint AIEE–ASME Committee on Turbo-generators. The American Society of Mechanical Engineers has asked the Institute to appoint a group to work with their committee on standardization of steam turbines of which K. M. Irwin, of the Philadelphia Electric Company, is chairman. Machines of 10,000 kw and up are to be covered. Chairman J. R. North of the Institute's Standard committee is now arranging with the various Institute committees concerned for the appointment of a mutually satisfactory group.

Industrial Control Apparatus. A revised edition of the American Standard for Industrial Control Apparatus, *C*19 (former AIEE Standard 15) is now out to letter ballot of the sectional committee.

PERSONAL • • • •

W. H. Harrison (A '20, F '31) brigadier general in charge of production activities of the services of supply, has been promoted to the rank of major general heading the Signal Corps' newly created procurement and distribution division. On leave from the American Telephone and Telegraph Company, New York, N. Y., since 1940, Major General Harrison has now resigned as vice-president of that company. He was born in Brooklyn, N. Y., June 11, 1892, and was graduated from Pratt Institute in 1915. He started his association with the Telephone company in 1909 with repair and installation work. He progressed to circuit design work in 1915 and from 1919 to 1924 was occupied with maintenance engineering. He was made equipment and building engineer in 1924 and plant engineer in 1928. In 1933 he was elected vice-president in charge of operations of the Bell Telephone Company of Pennsylvania and the Diamond State Telephone Company of Delaware. He was appointed assistant vice-president, department of operation and engineering, American Telephone and Telegraph Company in 1937. He became vice-president and chief engineer of the American Telephone and Telegraph Company in 1938. His first government post was that of head of the construction division of the National Defense Advisory Commission. With the creation of the Office of Production Management in 1941 he became chief of its shipbuilding, construction, and supplies. In September of that year he was appointed director of the OPM production division. He continued in that position when the War Production Board replaced the OPM in 1942. He was commissioned colonel in the United States Army in July 1942 and ten days later was raised to the rank of brigadier general. General Harrison was AIEE president in 1937–38 and vice-president in 1935–37. He has served on many AIEE committees including: the technical program committee, 1929–36; the publication committee, 1931–33; the committee on awards of Institute prizes 1931–34; the committee on communication, 1935–36; the Edison Medal committee, 1935–43; the Lamme Medal committee, 1935–38. As Institute representative he served on the following committees: the Alfred Noble Prize Committee, the Charles A. Coffin Fellowship and Research Fund Committee, the John Fritz Medal Board of Award, and the American Committee on Marking of Obstructions to Air Navigation.

F. E. Harrell (A '26, F '40) formerly assistant chief engineer, Reliance Electric and Engineering Company, Cleveland, Ohio, has been appointed chief engineer. He holds degrees of bachelor of science (1924)

and electrical engineer (1929) from Purdue University. Mr. Harrell joined the Reliance company in 1924 as sales engineer. He became design engineer in 1929, chief draftsman in 1929, and engineer in charge of a-c design in 1932. In 1934 he was made assistant chief engineer. For the past ten months he has been director of a new marine division plant of the Reliance company. Mr. Harrell was 1942–43 chairman of the AIEE electrical machinery committee on which he has served since 1926. He is also currently serving on the standards and technical program committees. He is a member of Tau Beta Pi and Eta Kappa Nu.

J. D. Leitch (A '37, M '42) formerly development engineer, Electric Controller and Manufacturing Company, Cleveland, Ohio, has been made chief engineer. He holds the degree of bachelor of science in electrical engineering from the University of Glasgow (1925) and the degrees of master of arts (1933) and doctor of philosophy (1939) in physics from the University of Toronto. From 1927 to 1930 he was lecturer in physics at the University of Toronto (Ont.). He was consultant physicist on radium and X rays for the Ontario Department of Health, Toronto, from 1932 to 1937 in connection with its cancer program. Having spent the years, 1930 to 1932, as Toronto sales representative of the Electric Controller company, he returned to the employ of the company in 1937 as development engineer.

R. S. Judd (A '31, M '35) formerly chief engineer, Southern New England Telephone Company, New Haven, Conn., has been elected vice-president in charge of personnel relations. After a short period with the Russell Tomlinson Electric Company, and its successor, the Rogers Telephone and Electric Company, Danbury, Conn., he was employed in the switchboard department of the Southern New England Telephone Company. In 1912 he became switchboard installation foreman and in 1913 specification writer for telephone central office equipment. He was made traffic engineer in 1920 and appointed chief engineer in 1930.

W. C. Redding (A '20) member of the technical staff, Bell Telephone Laboratories, New York, N. Y., has retired. He was graduated from Worcester Polytechnic Institute with the degree of bachelor of science in 1905 and received the degree of electrical engineer in 1906. From 1906 to 1911 he designed and supervised manufacture of electrical wires and cables for the American Steel and Wire Company, Worcester, Mass. In 1911 he joined the Western Electric Company, New York, N. Y., where he worked on lead-covered telephone cable development. Since 1925 he has continued with this work as a member of the staff of Bell Laboratories.

L. S. Ford (A '09) engineer, outside plant development department, Bell Telephone Laboratories, New York, N. Y., has retired. He holds the degrees of bachelor of science (1905) and electrical engineer (1906) from Worcester Polytechnic Institute. After one year with the Fire Underwriters, New York, N. Y., he joined Albert B. Herrick, Consulting Engineer, New York, N. Y., until 1909. In 1909 he entered the employ of the Western Electric Company, New York, N. Y. His work for that company and since 1925 for Bell Laboratories has been connected with the development of lead-covered cables.

Thomas Martin (A '35) electrician, City of Vancouver, B. C., has retired. Born in Walsall Wood, South Stafford, England, he commenced his career as assistant chief installer, Bell Telephone Company, Winnipeg, Man. From 1907 to 1912 he was journeyman and foreman for Cope and Sons, Vancouver. He started his 30 years of city employment as a journeyman in 1912. In 1928 he was made lighting superintendent and since 1935 he had been chief city electrician.

H. D. Hodgins (A '36, M '42) formerly application engineer, Westinghouse Electric and Manufacturing Company, Spokane, Wash., has been made manager of the company's Spokane office. He has been employed by the Westinghouse company since he graduated from the University of Idaho in 1923. Completing their student training course he became sales engineer for western Nevada and for Westinghouse service on the Grand Coulee Dam. He was transferred to Spokane in 1936.

A. S. Albright (M '37) formerly acting chief of research, Detroit (Mich.) Edison Company, has been made controller of the company. Mr. Albright has been employed by the Edison company since 1912. He was employed in the meter and statistical department until 1916 when he was made assistant superintendent of meters. He became superintendent of meters in 1918. In 1941 he was appointed acting chief of research.

C. S. Lumley (A '23, M '29) formerly co-ordinating engineer, Roller-Smith Company, Bethlehem, Pa., has been made assistant general manager of the company. Mr. Lumley became associated with the Roller-Smith Company in 1939 as district engineer in the Midwest district, Chicago, Ill. He was transferred to Bethlehem in 1942 as co-ordinating engineer for both the Bethlehem and Allentown, Pa., plants.

F. C. Angle (A '38) formerly manager of the San Francisco (Calif.) district of the Allis-Chalmers Manufacturing Company, has been appointed manager of the entire Pacific region. He received his degree of bachelor of science from Oregon State College in 1923 and joined the Allis-Chalmers company in 1929. He had been San Francisco manager since 1934.

G. D. McCann (A '38) transmission engineer, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., received his engineering degrees from the California Institute of Technology and not from the University of California as was reported in the July issue of *Electrical Engineering*.

K. J. Affanasiev (M '41) formerly engineer for special studies, Pennsylvania Water and Power Company, Baltimore, Md., is on wartime leave of absence. He has taken the position of development engineer in the air-borne instruments laboratory of Columbia University, New York, N. Y.

W. T. Grumbly (A '28, M '36) formerly engineer, Consolidated Edison Company of New York (N. Y.), Inc., is on wartime leave of absence from that company. He is now employed as a field engineer, division of war research, Columbia University, New York, N. Y.

G. G. Hyde (M '39) formerly staff engineer, Consolidated Edison Company of New York (N. Y.), Inc., has joined the firm of McKinsey and Company, New York, N. Y., as consultant in business and plant construction.

A. B. Cooper (M '16, F '33) general manager and vice-president, Ferranti Electric Company, Ltd., Toronto, Ont., has been elected a member of the executive council from Ontario of the Canadian Manufacturers Association.

M. C. Beebe (A '98, F '13) formerly with the Lea Manufacturing Company, Waterbury, Conn., is now chief development engineer, Hartford standard propeller division of the United Aircraft Company, East Hartford, Conn.

Leon Beauchamp (A '03, M '21) vice-president and chief engineer, the Solex Company, Ltd., Montreal, Que., has been elected a regional vice-president of the Illuminating Engineering Society.

Dean Harvey (A '03, M '13) materials engineer, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., has been elected president of the American Society for Testing Materials.

N. E. Cannady (A '18, M '25) state electrical engineer and inspector, state insurance department, Raleigh, N. C., has been appointed state civilian defense co-ordinator for electrical services.

A. C. Marshall (A '14, F '29) president and general manager of the Detroit (Mich.) Edison Company, has been awarded the honorary degree of doctor of arts in business administration by Wayne University.

G. H. Bucher (M '24) president of the Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa., has been awarded the honorary degree of electrical engineer by Stevens Institute of Technology.

F. B. Jewett (A '03, F '12) vice-president, American Telephone and Telegraph Company, New York, N. Y., has been elected charter member of the board of trustees of Princeton University.

C. F. Kettering (A '04, F '14) vice-president, General Motors Corporation, Dayton, Ohio, has been awarded the honorary degree of doctor of science by Columbia University.

A. D. Hinckley (A '27, M '38) assistant to the dean of the faculty of engineering, Columbia University, New York, N. Y., has been elected a director of the Illuminating Engineering Society.

T. D. Reimers (M '36) formerly division engineer, Consolidated Edison Company of New York (N. Y.), Inc., has been made electrical superintendent of the company's Hudson Avenue station.

H. S. Williams (A '41) assistant engineer, Rural Electrification Administration, St. Louis, Mo., and lieutenant, junior grade, United States Naval Reserve, has been called to active duty.

E. C. Molina (M '22) who retired from Bell Telephone Laboratories, New York, N. Y., in December 1942, is now with the Office of Scientific Research and Development, Washington, D. C.

Morton Sultzer (M '22) formerly executive assistant, systems development department, Bell Telephone Laboratories, Inc., New York, N. Y., is now a lieutenant colonel in the United States Army.

J. R. Reed (A '41) sales and field engineer' National Electric Coil Company, has been transferred to Salt Lake City, Utah, where he will be company representative for the territory west of Denver, Colo.

L. W. Robinson (A '25, M '30) of the engineering department, Commonwealth and Southern Corporation, Jackson, Mich., has been elected assistant secretary of the Consumers Power Company, Jackson.

J. P. Lewis (A '32, M '42) electrical engineer, Stamford, division, Connecticut Power Company, has been appointed assistant to the acting manager of the division.

R. M. Gates (M '35) president of the Air Preheater Corporation, New York, N. Y., has been nominated for the presidency of the American Society of Mechanical Engineers.

P. H. Goodell (A '40) formerly manager of the radiant heat division, C. M. Hall Lamp Company, Detroit, Mich., has joined the Trumbull Electric Manufacturing Company of that city.

Ralph Randall (A '35) sales engineer, General Electric Company, Oklahoma City, Okla., has been elected president of the Engineering Club of that city.

OBITUARY • • • •

William F. Grimes (A 19', M '27) captain, United States Navy, died June 26, 1943. Captain Grimes, was born February 21, 1895, in Pasadena, Calif. He was a member of the class of 1917 at the University of Southern California and was awarded the honorary degree of master of science by that university in 1942. During 1917 and 1918 he was attached to the staff of the commander in chief of the United States Fleet, working on maintenance of communication equipment. He was with the Bureau of Standards, Naval Radio Research Laboratory, Washington, D. C., (1918–19). From 1919 to 1924 he was expert radio aid in the Bureau of Engineering, Navy Department, Washington, D. C., and was also civilian in charge of radio design and construction. He engaged in sales and engineering work for the Westinghouse Electric and Manufacturing Company, Los Angeles, Calif., from 1925 to 1929. In 1929 he became control engineer. During this time he was also commander of the Naval Communications Reserve. In 1931 he joined the radio interference department of the Radio and Music Trades Association, Los Angeles, and in 1934 became chief engineer of the association. In 1936 he was made chief engineer of the Radio Interference Engineering Bureau and manager in 1937. Called back to active duty in 1941, he was appointed radio materials officer, 11th Naval District United States Naval Reserve, and later that year district communications officer. He was promoted from lieutenant commander to commander in 1941 and to captain in 1942. He served the Institute as a member of the communication committee from 1936 to 1939; as Los Angeles Section chairman in 1937–38; and as District secretary from 1939 to 1941. He was a member of the Institute of Radio Engineers and the author of numerous technical articles.

Charles Edward Stuart (M '18) president of Stuart, James and Cooke, Inc., New York, N. Y., died June 20, 1943. Born in Alexandria, Va., August 29, 1881, he graduated from the Virginia Military Institute in 1901 with the degree of electrical engineer. From 1902 to 1904 he worked in the apprenticeship department, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa. He served as sales engineer for the Westinghouse company from 1904 to 1910. Since 1911 he had been president of the engineering firm of Stuart, James and Cooke, Inc. During World War I he had charge of the power and light division of the United States Fuel Administration, established as part of the government's fuel conservation program. As consulting engineer to the Union of Soviet Socialist Republics, from 1926 to 1932, he prepared a report on operating conditions in coal, iron, and copper mines, which became the basis of Russian standards of mine operation. He undertook similar assignments in Great Britain and the United States, as well as in other European countries. He served as executive vice-president of the Export–Import Bank, Washington, D. C., from 1934 to 1936. In the latter year he was sent to Europe by President Roosevelt as a member of a commission of inquiry into co-operative enterprises in ten European countries. Recently he had been an associate member of the Power Commission of the War Industries Board, director of the American–Russian Chamber of Commerce, and a governing member of the National Foreign Trade Council. He was a member of the American Institute of Mining and Metallurgical Engineers and the author of a number of technical and economic articles.

Albert Kingsbury (A '08) president of the Kingsbury Machine Works, Frankford, Pa., died June 28, 1943. Born near Morris, Ill., December 22, 1862, he was graduated from Cornell University with the degree of mechanical engineer in 1889. He received the honorary degrees of doctor of engineering from Worcester Polytechnic Institute in 1933, and doctor of science from the University of New Hampshire in 1935. From 1891 to 1899 he was professor and head of the department of mechanical engineering at New Hampshire college, Durham, and in 1899 became professor of applied mechanics at Worcester (Mass.) Polytechnic Institute. He was employed by the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., from 1903 to 1910. Since then he had served the company in a consulting capacity. In 1917 he founded the Kingsbury Machine Works to manufacture the thrust bearing which he had invented. He had been president of the company since its incorporation in 1924. In 1942 the Army–Navy E was awarded the company for its contributions to naval architecture. Holder of numerous patents, Mr. Kingsbury received the gold medal of the American Society of Mechanical Engineers and the John Scott Medal of the City of Philadelphia in 1931, and the Elliott Cresson Medal of the Franklin Institute in 1923. He was an honorary member of the American Society of Mechanical Engineers and a fellow of the American Academy for the Advancement of Science. He was honored as "a modern pioneer" at the National Association of Manufacturer's celebration of the 150th anniversary of the patent system in 1940.

Ian Walter Grace (A '19) erecting engineer, Cory-Wright and Salmon, Campbells' Bay, Auckland, New Zealand, died June 2, 1943. He was born October 18, 1892, at Wanganui, New Zealand. Joining the Royal British Navy in 1907, he later entered the torpedo department. In 1910 he entered the Royal Naval Torpedo School and was appointed staff instructor in electric light and power at Portsmouth, England, in 1913. From 1913 until he was invalided out of service in 1915, he served as torpedo instructor aboard HMAS *Australia*. During 1915 he was chief electrician to the Dominion Portland Cement Company in New Zealand. He joined the New Zealand Expeditionary Force in 1916 and was given charge of electric power at Featherston Military Camp, England. In 1918 he became armature winder for the Waihi

(New Zealand) Grand Junction Gold Company. From 1919 to 1922 he was electrical engineer for the town board, Martinborough, Wairarapa, New Zealand. From 1923 to 1937 he was a partner in the firm of Dale and Grace, Martinborough. Since 1937 he had been erecting engineer with Cory-Wright and Salmon, Ltd.

Harrison Ivan Mickle (A '31) foreman, electrical department, Ford Instrument Company, Long Island City, N. Y., died July 27, 1943. Mr. Mickle, who was born July 26, 1888, in Hillsdale County, Mich., commenced his career as second engineer in the Electric Light and Water Power Station, Reading, Mich., in 1909. From 1913 to 1915 he did motor repair and general construction work for the Crandall Electrical Contracting Company, Jackson, Mich. He had charge of all electrical maintenance work for the American Fork and Hoe Company, Jackson, from 1915 to 1917. During World War I, 1917 to 1919, he was employed at the Brooklyn (N. Y.) Navy Yard. In 1919 he became foreman of the electrical repair shop of The Maintenance Company, New York, N. Y., and from 1921 to 1924 he had charge of the motor repair work of the Eisenberg General Contracting Company, New York, N. Y. He had been foreman at the Ford company since 1925.

Walter Scott Wyman (A '03, M '14, F '19) president of the New England Public Service Company, Augusta, Maine, died November 15, 1942. He was born May 6 1874, in Oakland, Maine. From 1896 to 1899 he was assistant superintendent of the Maine Water Company, Portland. In 1899 he was elected general manager of the Waterville and Fairfield (Maine) Railway and Light Company. He resigned this position in 1901 to organize the Messalonskee Electric Company, Waterville and Oakland, which became the Central Maine Power Company in 1909. After serving as general manager of this company from 1901 to 1910, he assumed the additional duties of treasurer in the latter year. From 1917 to 1920 he was also general manager of the Adirondack Electric Power Corporation, Glens Falls, N. Y. In 1924 he became president of the Central Maine company and since 1926 he had been president of the New England Public Service Company.

Keith Elias Sharp (A '35) general superintendent and chief engineer, Cimarron Utilities Company, Texhoma, Okla., died May 24, 1943. Born September 8, 1903, at Medford, Okla., he graduated from the University of Kansas with the degree of bachelor of science in electrical engineering in 1926. During 1926 he worked as statistical engineer and substation engineer for the Kansas City (Mo.) Power and Light Company and as design engineer for the Guanajuato (Gto.) Power and Electric Company, Mexico. From 1926 to 1930, as engineer for the Panhandle Power and Light Company, Borger, Tex., he mapped electric, gas, and water distribution systems. In 1930 he joined the Cimarron company as general superintendent and chief engineer. As such, he was in charge of all engineering construction and operation. He was a member of Tau Beta Pi.

Telford MacLennan (A '12) retired engineer, Remuera, Auckland, New Zealand, died June 12, 1943. Born October 8, 1885, at Tapanui, New Zealand, he was graduated from Canterbury College, New Zealand University, with the degree of bachelor of engineering. From 1907 to 1909 he was entered in an apprenticeship course, Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa. He was erecting engineer with the Westinghouse company at Chicago, Ill., from 1909 to 1911, and at Winnipeg, Man., during 1912. From 1915 to 1920 he was engineer with the New Zealand government's Hydro-Electric Scheme, Lake Coleridge, Canterbury, New Zealand. In 1921 he became district electrical engineer in the public works department, Hamilton, New Zealand. He retired in 1938.

MEMBERSHIP • •

Applications for Election

Applications have been received at headquarters from the following candidates for election to membership in the Institute. Names of applicants in the United States and Canada are arranged by geographical District. Any member objecting to the election of any of these candidates should so inform the national secretary before September 31, 1943, or November 30, 1943, if the applicant resides outside of the United States or Canada.

To Grade of Member

Birdwell, C. T. (Re-election), Curtiss-Wright Corp., Louisville, Ky.
Brown, H. D. (Re-election), General Elec. Co., Schenectady, N. Y.
Garbett, R. A., Crescent Pub. Serv. Co., Wilmington, Del.
Harmer, L. B. (Re-election), Brit. E. African Govt., Nairobi, B. E. A.
Holland, L. N. (Re-election), Univ. of Michigan, Ann Arbor, Mich.
Marty, E. O., Parsons, Brinckerhoff, Hogan & McDonald, New York, N. Y.
Rollman, W. H. (Re-election), Chem. Warfare Serv., U. S. War Dept., Pine Bluff, Ark.
Stevens, K. M. (Re-election), So. Calif. Edison Co. Ltd., Alhambra, Calif.
Stivender, E. H., Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Walker, G. H., Boeing Aircraft Co., Renton, Wash.
Woodruff, R. T. (Re-election), Aluminum Ore Co., St. Louis, Mo.

To Grade of Associate

United States and Canada

1. North Eastern

Abbiati, O., Radiation Lab., MIT, Cambridge, Mass.
Flock, W. L., Radiation Lab., MIT, Cambridge, Mass.
Hafkemeyer, E. E., Jr., General Elec. Co., Schenectady, N. Y.
Hubbard, M. M., Radiation Lab., MIT, Cambridge, Mass.
Laudel, A., Jr., General Elec. Co., Schenectady, N. Y.
Metzger, H. C., General Elec. Co., Bridgeport, Conn.

2. Middle Eastern

Burke, T. A. (Re-election), Villanova College, Villanova, Pa.
Carl, W. C. (Re-election), Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.
Ditton, J. A., Jr., Bethlehem Steel Co., Bethlehem, Pa.
Fritz, D. E., Westinghouse Elec. & Mfg. Co., Lima, Ohio.
Glick, W. D., Jr., Lancaster Electronics Lab., Lancaster, Pa.
Irwin, T. R., Line Material Co., Zanesville, Ohio.
Jensen, C. H. (Re-election), Copperweld Steel Co., Glassport, Pa.
Loose, H. A., Truscon Steel Co., Cleveland, Ohio.
McKenna, G. W., Jr., General Elec. Co., Philadelphia, Pa.
McMahon, E. G., Ohio Power Co., Philo, Ohio.
Moore, M. N., Office, Chief of Signal Office, Washington, D. C.
Reifschneider, P. J., Gen. Elec. Co., Philadelphia, Pa.
Shuoy, P. F., North Elec. Mfg. Co., Galion, Ohio.
Stadum, C. B., Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.
Yaffee, P., Naval Ordnance Lab., Washington, D. C.

3. New York City

Blume, W. E. (Re-election), W. E. Blume, Inc., Brooklyn, N. Y.
Metz, A. W., Weston Elec. Inst. Corp., Newark, N. J.
Samuelson, B., U. S. Navy Yard, Brooklyn, N. Y.
Thieme, G. B., Bendix Aviation Corp., Brooklyn, N. Y.
Thompson, G. O., M. W. Kellog Co., New York, N. Y.

4. Southern

Galaher, D., Fla. Power Corp., St. Petersburg, Fla.
Garcia, I. L., Fla. Power Corp., St. Petersburg, Fla.
Huiell, B. V., 1st Lt., USA, Maxwell Field, Montgomery, Ala.
McDonald, J. S., U. S. Navy, New Orleans, La.
McKee, S. E., Pleasantville Constructors, Inc., Miami, Fla.
Moyers, W. R., Jr., Giffels & Vallet, Inc., Naval Operating Base, Norfolk, Va.
Shedd, R. R., Westinghouse Elec. & Mfg. Co., Chattanooga, Tenn.
Smith, B., Jr., Aluminum Co. of America, Alcoa, Tenn.
Waugh, W. H. H., Jr., T. V. A., Muscle Shoals, Ala.

5. Great Lakes

Ehret, E. L., Aluminum Ore Co., East St. Louis, Ill.
Johnston, C. G., Northern Indiana Pub. Serv. Co., Plymouth, Ind.
Kohlhepp, R. A. H., Allis-Chalmers Mfg. Co., West Allis, Wis.
Quinn, G. C., Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Servis, H., Dumore Co., Racine, Wis.
Snowdon, A. E., Univ. of Illinois, Chicago, Ill.
Willis, C. R., Northern Indiana Pub. Serv. Co., Plymouth, Ind.

7. South West

Jones, S. O., U. S. Engineers, Tulsa, Okla.
Shepherd, R. J., U. S. Engr. Office, Denison, Texas.
Thomas, M. F., U. S. Engr. Office, Denison, Texas.

8. Pacific

Becker, H. W., Mare Island Navy Yard, Mare Island, Calif.
Geering, F. R., Pacific Gas & Elec. Co., Oakland, Calif.
Kotnik, E. F., Consol. Vultee Aircraft Corp., San Diego, Calif.
Johnson, C. E., Southern Calif. Tel Co., Los Angeles, Calif.
Rule, J. S., Pacific Gas & Elec. Co., Oakland, Calif.
Snyder, A. T., Flotation Systems, Inc., Los Angeles, Calif.
Stevens, C. H., Consolidated Aircraft Corp., San Diego, Calif.
Wertheimer, A., Westinghouse Elec. & Mfg. Co., Emeryville, Calif.
Woodbury, H. L., City of Glendale, Glendale, Calif.
Woolley, F. B., U. S. Navy Yard, Mare Island, Calif.

9. North West

Belschner, W. F., Columbia Steel Co., Salt Lake City, Utah.
Hattrup, H. E., Univ. of Idaho, Moscow, Idaho.
Howell, H. H., Boeing Aircraft Co., Seattle, Wash.
Miller, W. B., Seattle-Tacoma Shipbldg. Corp., Tacoma, Wash.

10. Canada

Kersey, L. R. (Re-election), University of British Columbia, Vancouver, B. C., Can.

Elsewhere

Akre Montano, E. O. (Re-election), Mexican Lt. & Pr. Co., Mexico, D. F., Mex.
Brewer, R. C., Admiralty Signal Est., Glossop, Derbyshire, England.
Cadman, T. F., Lt. R.N.V.R., Port of Swansea, South Wales.
Canagarayar, Rajakariar (Re-election), Colombo Mun. Council, Colombo, Ceylon.
Littler, H. A., I.C.I. (Alkali) Ltd., Norwich, England.
Sanchez Zarazua, J. R. (Re-election), Mexican Lt & Pr. Co., Mexico, D. F., Mex.
Saunders, E. D., Jamaica Pub. Serv. Co., Ltd., Kingston, Jamaica, B. W. I.
Williams, H. E., Royal Navy, New Haven, Sussex, England.

Total to grade of Associate
United States and Canada, 60
Elsewhere, 8

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NEVIN E. FUNK Philadelphia, Pa.
(*Term expires July 31, 1944*)

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(*Term expires July 31, 1945*)

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(*Terms expire July 31, 1944*)

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(*Terms expire July 31, 1946*)

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(*Terms expire July 31, 1947*)

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(*Term expires July 31, 1944*)

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(*Term expires July 31, 1944*)

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FRANCE—A. S. Garfield, 173 Boulevard Haussmann, Paris, 8E

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(*Terms expire July 31, 1946*)

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(*Terms expire July 31, 1944*)

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(*Terms expire July 31, 1944*)

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Allan R. Dixon (3) Ralph A. Hopkins (8)
Stanley Warth (4) Richard Setterstrom (9)
LeRoy A. Griffith (5) Frederick Krug (10)

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Chairmen of Working and Coordinating Committees of the Standards Committee
Chairmen of AIEE Technical Committees
Chairmen of AIEE delegates on other standardizing bodies or sole representatives thereon
President, U. S. National Committee of the International Electrotechnical Commission

Student Branches

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Ex officio

Chairmen of all technical committees, the committee on planning and co-ordination, the committee on safety, and the standards committee

Transfers

M. J. McHenry, *chairman*, Hydro-Electric Power Commission, 620 University Ave., Toronto, Ontario

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F. F. Ambuhl, *chairman*, Toronto Hydro-Electric System, 14 Carlton St., Toronto, Ontario

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J. D. Tebo, *secretary*, 463 West Street, New York 14, N. Y.

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Communication

H. A. Affel, *chairman*, Bell Telephone Laboratories, 463 West St., New York 14, N. Y.

A. L. Albert, H. H. Beverage, J. D. Booth, F. B. Bramhall, R. S. Burnap, J. L. Callahan, D. E. Chambers, I. S. Coggeshall, J. B. Coleman, F. A. Cowan, John Davidson, Jr., H. C. Dillingham, D. D. Geiger, E. E. George, C. G. Grimes, E. W. Hamlin, A. P. Hill, S. B. Ingram, G. W. Janson, E. P. Yerkes, H. E. Kent, D. K. Lippincott, E. T. Mahood, L. R. Mapes, J. R. Martin, R. G. McCurdy, C. W. Mier, H. H. Nance, H. H. Newell, E. J. O'Connell, L. G. Pacent, J. G. Patterson, Haraden Pratt, John B. Russell, Arthur Bessey Smith, R. E. Smith, Warner T. Smith, H. M. Turner, W. C. White

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Education

Robin Beach, *chairman*, Polytechnic Institute of Brooklyn, 99 Livingston St., Brooklyn, N. Y.

H. W. Bibber, G. F. Corcoran, O. E. Edison, S. L. Henderson, M. C. Hughes, E. B. Kurtz, Everett S. Lee, W. A. Murray, J. A. Northcott, Jr., R. G. Porter, C. A. Powel, H. C. Powell, C. W. Ricker, H. H. Skilling, R. W. Sorensen, J. G. Tarboux, B. R. Teare, Jr., G. B. Thomas, H. N. Walker, R. W. Warner

Electrical Machinery

F. E. Harrell, *chairman*, 1088 Ivanhoe Road, Cleveland, Ohio

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Electronics

S. B. Ingram, *chairman*, Bell Telephone Laboratories, 463 West St., New York 14, N. Y.

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A. G. Oehler, *chairman*, Simmons-Boardman Publishing Co., 30 Church St., New York 7, N. Y.
H. C. Griffith, *vice-chairman*, 1617 Pennsylvania Blvd., Philadelphia, Pa.
P. H. Hatch, *secretary*, 514 Siwanoy Place, Pelham Manor, N. Y.

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Marine Transportation

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Technical Committees (continued)

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E. I. Green, *secretary*, Bell Telephone Laboratories, 180 Varick St., New York 14, N. Y.

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W. N. Goodwin, Jr. — W. E. Pakala
Stanley Green — G. R. Patterson
C. M. Hathaway — E. G. Ratz
N. S. Hibshman — A. R. Rutter
G. B. Hoadley — F. B. Silsbee
F. C. Holtz — Roy M. Smith
H. M. Turner

Power Transmission and Distribution

H. E. Wulfing, *chairman*, Commonwealth Edison Co., 72 W. Adams St., Chicago, Ill.

D. L. Beeman — H. E. Kent
D. K. Blake — A. A. Kroneberg
C. D. Brown — C. M. Laffoon
H. W. Clark — W. W. Lewis
Harold Cole — J. T. Lusignan
C. A. Corney — L. M. Moore
S. B. Crary — E. W. Oesterreich
R. F. Danner — J. S. Parsons
A. E. Davison — W. S. Peterson
G. E. Dean — L. M. Robertson
R. D. Evans — S. J. Rosch
L. R. Gaty — E. V. Sayles
C. M. Gilt — A. E. Silver
I. W. Gross — F. V. Smith
Herman Halperin — Philip Sporn
Edwin Hansson — Stanley Stokes
K. E. Hapgood — O. W. Titus
C. A. Harrington — J. J. Torok
J. B. Hodtum — H. M. Trueblood
E. K. Huntington — C. F. Wagner
J. P. Jollyman — R. J. Wiseman — L. T. Williams

Therapeutics, Applications of Electricity to

C. V. Aggers, *chairman*, Westinghouse Elec. & Mfg. Co., X-Ray Div., 2519 Wilkins Ave., Baltimore 3, Md.

Lloyd L. Call — W. B. Kouwenhoven
W. D. Coolidge — H. C. Rentschler
Roy Kegerreis — C. W. Ricker

Protective Devices

J. B. MacNeill, *chairman*, Westinghouse Electric & Mfg. Company, East Pittsburgh, Pa.

A. E. Anderson — W. A. Lewis
H. D. Braley — S. C. Leyland
O. E. Charlton — H. J. Lingal
J. E. Clem — F. R Longley
H. W. Collins — L. R. Ludwig
F. W. Cramer — J. R. McFarlin
William Deans — J. R. North
F. M. Defandorf — H. V. Nye
G. B. Dodds — S. C. Poage
W. S. Edsall — H. H. Rudd
F. R. Ford — W. J. Rudge
L. R. Gamble — H. P. St. Clair
I. W. Gross — A. H. Schirmer
H. W. Haberl — H. P. Sleeper
F. C. Hanker — C. L. Smith
E. L. Harder — F. V. Smith
R. T. Henry — Roy M. Smith
P. A. Jeanne — H. R. Stewart
L. F. Kennedy — H E. Strang
H. E. Kent — H. R. Summerhayes
A. A. Kroneberg — P. L. Taylor
R. A. Larner — J. J. Tesar
T. G. LeClair — J. M. Towner
J. D. Wood

Special Committee

Registration of Engineers

C. R. Beardsley, *chairman*, New York City Department of Commerce, 60 Broadway, Room 1404, New York 4, N. Y.

A. T. Campbell — T. G. LeClair
Tomlinson Fort — K. B. McEachron
N. B. Hinson — W. H. Stueve
J. G. Wray

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Robin Beach

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T. H. Morgan — I. Melville Stein

American Committee on Marking of Obstructions to Air Navigation
G. E. Dean — H. L. Huber

American Coordinating Committee on Corrosion
H. S. Phelps

American Research Committee on Grounding
C. T. Sinclair

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R. T. Henry — J. R. North — H. S. Osborne
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National Fire Protection Association, Electrical Committee
W. Ralph Smith — F. V. Magalhaes, Alternate

National Fire Waste Council
Wills Maclachlan — W. Ralph Smith

(*Continued on next page*)

Geographical District Executive Committees

	District	Chairman (Vice-President, AIEE)	Secretary (District Secretary)	Chairman, District Committee on Student Activities
1	North Eastern	K. B. McEachron, General Electric Company, 100 Woodlawn Ave., Pittsfield, Mass.	Victor Siegfried, Worcester Polytechnic Institute, Worcester, Mass.	R. G. Porter, Northeastern University, Boston, Mass.
2	Middle Eastern	W. E. Wickenden, Case School of Applied Science, Cleveland 6, Ohio	H. R. Vaughan, Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.	R. C. Gorham, University of Pittsburgh, Pittsburgh, Pa.
3	New York City	C. R. Jones, Westinghouse Elec. & Mfg. Co., 40 Wall St., New York 5, N. Y.	R. L. Webb, Consolidated Edison Co. of New York, Inc., 4 Irving Place, New York 3, N. Y.	D. H. Wright, Pratt Institute, Brooklyn, N. Y.
4	Southern	C. W. Ricker, Tulane University, New Orleans 15, La.	F. E. Johnson, Jr., 317 Baronne St., New Orleans 9, La.	Claudius Lee, Virginia Polytechnic Institute Blacksburg, Va.
5	Great Lakes	A. G. Dewars, Northern States Power Co., 15 S. 5th St., Minneapolis, Minn.	N. C. Pearcy, Public Utility Engg. & Service Corp., 231 S. La Salle St., Chicago, Ill.	H. O. Warner, University of Detroit, Detroit, Mich.
6	North Central	L. A. Bingham, University of Nebraska, Lincoln, Nebr.	Frank C. Howard, Iowa-Nebraska Light & Power Co., Lincoln, Nebr.	(To be appointed)
7	South West	E. T. Mahood, Southwestern Bell Telephone Co., 11th & Oak Sts., Kansas City, Mo.	R. G. Kloeffler, Kansas State College, Manhattan, Kans.	M. A. Thomas, New Mexico State College, State College, N. M.
8	Pacific	J. M. Gaylord, Metropolitan Water District of Southern California, 306 W. 3rd St., Los Angeles, Calif.	Mark A. Sawyer, Box 5300 Metropolitan Station, Los Angeles, Calif.	F. W. Maxstadt, California Institute of Technology, Pasadena 4, Calif.
9	North West	E. W. Schilling, Montana State College, Bozeman, Mont.	W. A. Boyer, Anaconda Copper Mining Co., Butte, Mont.	R. E. Lindblom, University of Washington, Seattle, Wash.
10	Canada	W. J. Gilson, 1244 Dufferin St., Toronto, Ont.	W. Roy Harmer, H.E.P.C. of Ontario, 620 University Ave., Toronto, Ont.	

NOTE: Each District executive committee includes also the chairmen and secretaries of all Sections within the District, and the District vice-chairman of the national membership committee.

Institute Representatives (cont.)

National Research Council, Division of Engineering and Industrial Research
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W. A. Lewis

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Washington Award Commission
H. B. Gear L. R. Mapes

World Power Conference, Executive Committee of U. S. National Committee
Nevin E. Funk

General Counsel

Parker & Aaron
20 Exchange Place, New York 5, N. Y.

Student Branches of the Institute

Name and Location	District	Counselor (Member of Faculty)
Akron, Univ. of, Akron, Ohio	2	J. B. Fairburn
Alabama Polytechnic Inst., Auburn	4	W. W. Hill
Alabama, Univ. of, University	4	W. J. Miller
Alberta, Univ. of, Edmonton, Can.	10	
Arizona, Univ. of, Tucson	8	J. C. Clark
Arkansas, Univ. of, Fayetteville	7	W. B. Stelzner
British Columbia, Univ. of, Vancouver, Can.	10	W. B. Coulthard
Brooklyn, Polytechnic Inst. of, Brooklyn, N. Y.	3	A. B. Giordano
Brown Univ., Providence, R. I.	1	E. N. Tompkins
Bucknell Univ., Lewisburg, Pa.	2	K. B. MacKichan
Calif. Inst. of Tech., Pasadena	8	F. W. Maxstadt
Calif., Univ. of, Berkeley	8	P. L. Morton
Carnegie Inst. of Tech., Pittsburgh, Pa.	2	G. R. Patterson
Case School of Applied Science, Cleveland, Ohio	2	P. L. Hoover
Catholic Univ. of America, Washington, D. C.	2	T. J. MacKavanagh
Cincinnati, Univ. of, Cincinnati, Ohio	2	L. R. Culver
Clarkson College of Technology, Potsdam, N. Y.	1	A. R. Powers
Clemson Agricultural College, Clemson, S. C.	4	F. T. Tingley
Colorado State Col. of A. & M. Arts, Fort Collins	6	F. B. Beatty
Colorado, Univ. of, Boulder	6	H. B. Palmer
Columbia Univ., New York, N. Y.	3	J. R. Ragazzini
Connecticut, Univ. of, Storrs	1	G. S. Timoshenko
Cooper Union, New York, N. Y.	3	E. E. Shelton
Cornell Univ., Ithaca, N. Y.	1	E. T. B. Gross
Delaware, Univ. of, Newark, Del.	2	M. G. Young
Denver, Univ. of, Denver, Colo.	6	A. Benson
Detroit, Univ. of, Detroit, Mich.	5	H. O. Warner
Drexel Inst. of Technology, Philadelphia, Pa.	2	E. O. Lange
Duke Univ., Durham, N. C.	4	Otto Meier, Jr.
Florida, Univ. of, Gainesville	4	E. F. Smith
George Washington Univ., Washington, D. C.	2	A. G. Ennis
Georgia School of Technology, Atlanta	4	H. B. Duling
Harvard Univ., Cambridge, Mass.	1	
Idaho, Univ. of, Moscow	9	J. Hugo Johnson
Illinois Inst. of Technology, Chicago	5	E. H. Freeman
Illinois, Univ. of, Urbana	5	E. A. Reid
Iowa State Col., Ames	5	B. S. Willis
Iowa, Univ. of, Iowa City	5	H. R. Reed
Johns Hopkins Univ., Baltimore, Md.	2	F. Hamburger
Kansas State Col., Manhattan	7	J. E. Ward, Jr.
Kansas, Univ. of, Lawrence	7	G. A. Richardson
Kentucky, Univ. of, Lexington	4	E. A. Bureau
Lafayette Col., Easton, Pa.	2	F. W. Smith
Lehigh Univ., Bethlehem, Pa.	2	J. L. Beaver
Louisiana State Univ., Baton Rouge	4	A. K. Ramsey
Louisville, Univ. of, Louisville, Ky.	4	M. G. Northrop
Maine, Univ. of, Orono	1	N. E. Wilson
Manhattan Col., New York, N. Y.	3	R. T. Weil
Marquette Univ., Milwaukee, Wis.	5	E. W. Kane
Maryland, Univ. of, College Park	2	L. J. Hodgins
Mass. Inst. of Technology, Cambridge 39	1	K. L. Wildes
Michigan Col. of Mining & Tech., Houghton	5	Chester Russell
Michigan State Col., East Lansing	5	M. M. Cory
Michigan, Univ. of, Ann Arbor	5	J. S. Gault
Milwaukee School of Engg., Milwaukee, Wis.	5	E. L. Wiedner
Minnesota, Univ. of, Minneapolis	5	J. H. Kuhlmann
Mississippi State Col., State College	4	N. M. McCorkle
Missouri School of Mines & Met., Rolla	7	J. Stuart Johnson
Missouri, Univ. of, Columbia	7	D. Waidelich
Montana State Col., Bozeman	9	E. W. Schilling
Nebraska, Univ. of, Lincoln	6	O. E. Edison
Nevada, Univ. of, Reno	8	S. G. Palmer
Newark Col. of Engineering, Newark, N. J.	3	F. A. Russell
New Hampshire, Univ. of, Durham	1	W. B. Nulsen
New Mexico State Col., State College	7	M. A. Thomas
New Mexico, Univ. of, Albuquerque	7	R. W. Tapy
New York, Col. of the City of, New York	3	Harry Baum
New York Univ., New York	3	P. C. Cromwell
North Carolina State Col., Raleigh	4	L. M. Keever
North Dakota State Col., Fargo	5	H. S. Rush
North Dakota, Univ. of, Grand Forks	5	C. W. Rook
Northeastern Univ., Boston, Mass.	1	R. G. Porter
Northwestern Univ., Evanston, Ill.	5	R. W. Jones
Norwich Univ., Northfield, Vt.	1	D. E. Howes
Notre Dame, Univ. of, Notre Dame, Ind.	5	J. A. Northcott
Ohio Northern Univ., Ada	2	D. S. Pearson
Ohio State Univ., Columbus	2	S. O. Evans
Ohio Univ., Athens	2	W. M. Young
Oklahoma A. & M. College, Stillwater	7	A. Naeter
Oklahoma, Univ. of, Norman	7	R. A. Church
Oregon State Col., Corvallis	9	W. H. Huggins
Pennsylvania State Col., State College	2	P. X. Rice
Pennsylvania, Univ. of, Philadelphia	2	S. R. Warren, Jr.
Pittsburgh, Univ. of, Pittsburgh, Pa.	2	R. C. Gorham
Pratt Institute, Brooklyn, N. Y.	3	D. H. Wright
Princeton Univ., Princeton, N. J.	2	W. C. Johnson
Puerto Rico, Univ. of, Mayaguez, P. R.	3	G. F. Anton
Purdue Univ., Lafayette, Ind.	5	J. H. Karr
Rensselaer Polytechnic Inst., Troy, N. Y.	1	E. D. Broadwell
Rhode Island State Col., Kingston	1	W. J. Mowbray
Rice Inst., Houston, Tex.	7	C. R. Wischmeyer
Rose Polytechnic Inst., Terre Haute, Ind.	5	C. C. Knipmeyer
Rutgers Univ., New Brunswick, N. J.	3	J. L. Potter
Santa Clara, Univ. of, Santa Clara, Calif.	8	W. J. Warren
South Carolina, Univ. of, Columbia	4	W. M. Bauer
South Dakota State College, Brookings	5	W. H. Gamble
South Dakota State School of Mines, Rapid City	6	E. E. Clark
Southern California, Univ. of, Los Angeles, Calif.	8	P. S. Biegler
Southern Methodist Univ., Dallas, Tex.	7	E. H. Flath
Stanford Univ., Stanford University, Calif.	8	H. H. Skilling
Stevens Inst. of Technology, Hoboken, N. J.	3	W. L. Sullivan
Swarthmore Col., Swarthmore, Pa.	2	J. D. McCrumm
Syraucuse Univ., Syracuse, N. Y.	1	C. W. Henderson
Tennessee, Univ. of, Knoxville	4	W. O. Leflell
Texas A. & M. Col., College Station	7	N. F. Rode
Texas Technological Col., Lubbock	7	C. V. Bullen
Texas, Univ. of, Austin	7	R. A. Galbraith
Tufts College, Tufts College, Mass.	1	A. H. Howell
Tulane Univ., New Orleans 15, La.	4	J. A. Cronvich
Union Col., Schenectady 5, N. Y.	1	H. W. Bibber
Utah, Univ. of, Salt Lake City	9	L. Dale Harris
Vanderbilt Univ., Nashville, Tenn.	4	S. R. Schealer
Vermont, Univ. of, Burlington	1	E. R. McKee
Villanova Col., Villanova, Pa.	2	H. S. Bueche
Virginia Military Inst., Lexington	4	J. S. Jamison
Virginia Polytechnic Inst., Blacksburg	4	Claudius Lee
Virginia Univ. of, University	4	J. S. Miller
Washington, State College of, Pullman	9	H. F. Lickey
Washington, Univ. of, Seattle	9	R. E. Lindblom
Washington Univ., St. Louis, Mo.	7	D. A. Fischer
West Virginia Univ., Morgantown	2	A. H. Forman
Wisconsin, Univ. of, Madison	5	J. R. Price
Worcester Polytechnic Inst., Worcester, Mass.	1	V. Siegfried
Wyoming, Univ. of, Laramie	6	G. H. Sechrist
Yale Univ., New Haven, Conn.	1	A. G. Conrad
Total Branches	125	

Local Sections of the Institute

Name	District	When Organized	Membership Aug. 1, 1943	Chairman	Secretary	Secretary's Address
Akron	2	Aug. 12, '20	87	R. F. Snyder	H. N. Van Aken	304 Akron Savings & Loan Bldg., Akron, Ohio
Alabama	4	May 22, '29	42	E. R. Coulbourn	C. F. Sittloh	1329—17th St., S. W., Birmingham 7, Ala.
Arizona	8	Mar. 22, '41	37	Malcolm Bridgwater	E. A. Gissel	Central Arizona Light & Power Co., Phoenix, Ariz.
Boston	1	Feb. 13, '03	574	T. Cooper, Jr.	W. I. Middleton	Simplex Wire & Cable Co., Cambridge, Mass.
Central Indiana	5	Jan. 12, '12	133	C. R. Swenson	C. E. Parks	Public Service Co. of Indiana, Inc., Indianapolis, Ind.
Chicago	5	1893	849	F. E. Keith	R. C. Ericson	Northern Indiana Public Service Co., Hammond, Ind.
Cincinnati	2	June 30, '20	151	V. G. Rettig	W. H. Breunig	2411 Upland Place, Cincinnati 6, Ohio
Cleveland	2	Sept. 27, '07	368	P. L. Hoover	V. A. Diggs	Ohio Bell Telephone Co., 750 Huron Rd., Cleveland, Ohio
Columbus	2	Mar. 17, '22	82	S. O. Evans	R. W. Miner	323 No. Ardmore Road,, Columbus 9, Ohio
Connecticut	1	Apr. 16, '21	365	E. C. Brown	C. D. Hewitt	P.O. Box 1562, New Haven 6, Conn.
Dayton	2	June 9, '43	122	L. J. Fritz	J. W. Gehrke	Dayton Power & Light Co., 25 No. Main St., Dayton 2, Ohio
Denver	6	May 18, '15	186	W. H. Taylor	L. R. Patterson	Public Service Co. of Colorado, Denver, Colo.
East Tennessee	4	Sept. 2, '36	134	R. M. Ferrill	H. W. Hutchcraft	Tennessee Valley Authority, Chattanooga, Tenn.
Erie	2	Jan. 11, '18	71	H. N. Shaw	W. D. Bearce	4121 Sassafras St., Erie, Pa.
Florida	4	Jan. 28, '31	136	C. F. Titus	P. J. Carlin	Florida Power & Light Co., Miami, Fla.
Fort Wayne	5	Aug. 14, '08	100	C. W. Kronmiller	E. G. Downie	General Electric Co., Fort Wayne, Ind.
Georgia	4	Jan. 14, '04	101	J. E. Mellett	Carl Evans	Electrical South, 1020 Grant Bldg., Atlanta 3, Ga.
Houston	7	Aug. 7, '28	153	H. P. Heafer	Hezzie Clark	P.O. Drawer 2220, Houston 1, Tex.
Iowa	5	June 25, '29	80	W. B. Boast	E. B. Fowler	Northwestern Bell Telephone Co., Des Moines, Iowa
Ithaca	1	Oct. 15, '02	60	A. B. Credle	W. E. Meserve	Cornell University, Ithaca, N. Y.
Kansas City	7	Apr. 14, '16	143	V. P. Hessler	S. H. Pollock	Box 679, Kansas City 10, Mo.
Lehigh Valley	2	Apr. 16, '21	189	R. M. Wyatt	L. Z. Ludorf	Penn. Pwr. & Lt. Co., 135 N. Washington St., Wilkes Barre, Pa.
Los Angeles	8	May 19, '08	548	L. F. Hunt	E. S. Condon	357 South Hill St., Los Angeles 13, Calif.
Louisville	4	Oct. 15, '26	75	L. G. Weiser	M. S. Winstandley	Louisville Gas & Elec. Co., Louisville, Ky.
Lynn	1	Aug. 22, '11	202	W. R. Cox	C. A. Atherton	Champion Lamp Works, 600 Broad St., Lynn, Mass.
Madison	5	Jan. 8, '09	75	L. C. Larson	F. D. Mackie	1202 Elizabeth St., Madison, Wis.
Mansfield	2	Mar. 6, '39	68	R. Felver	C. S. Duckwald	R.D. 5-Rear, 720 Lexington Ave., Mansfield, Ohio
Maryland	2	Dec. 16, '04	349	M. W. Pullen	J. L. Hildebrandt	Consol. Gas Elec. Lt. & Pwr. Co., Monument St. Bldg., Baltimore 3, Md.
Memphis	4	May 22, '30	57	J. F. Fossick	M. G. Sifford	Westinghouse Electric Supply Co., Memphis 1, Tenn.
Mexico	3	June 29, '22	57	G. Robles	Jose Rosas	Mexican Light & Power Co. Ltd., Mexico, D.F. Mexico
Michigan	5	Jan. 13, '11	393	J. W. Bishop	M. M. Cory	Michigan State College, East Lansing, Mich.
Midwestern Canada	10	Oct. 14, '25	26	M. L. Haynes	J. R. Young	1945 Scarth St., Regina, Sask., Can.
Milwaukee	5	Feb. 11, '10	318	R. H. Earle	E. L. McClure	Wisconsin Elec. Pwr. Co., 231 W. Michigan St., Milwaukee 3, Wis.
Minnesota	5	Apr. 7, '02	118	W. H. Gille	L. A. Griffith	Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Montana	9	June 24, '31	40	C. R. Davis	W. H. Blankmeyer	Montana Power Co., Butte, Mont.
Montreal	10	Apr. 16, '43	149	Frederick Krug	D. M. Farnham	107 Craig St. West, Room 307, Montreal, Que., Can.
Muscle Shoals	4	Feb. 18, '38	23	R. C. Fuller	Arthur Vaughn	702 Commons, Tuscumbia, Ala.
Nebraska	6	Jan. 21, '25	50	C. P. Kahler	I. M. Ellestad	Northwestern Bell Telephone Co., Omaha, Nebr.
New Mexico–West Texas	7	Mar. 7, '40	48	E. C. Wise	L. R. Hammond, Jr.	2910 Grant Ave., El Paso, Tex.
New Orleans	4	Dec. 8, '33	141	C. P. Knost	F. E. Johnson	317 Baronne St., New Orleans 9, La.
New York	3	Dec. 10, '19	3,586	C. S. Purnell	J. L. Callahan	R.C.A. Communications, Inc., 66 Broad St., New York 4, N. Y.
Niagara Frontier	1	Feb. 10, '25	186	C. E. Gaylord	W. J. Freudenberger	Buffalo Niagara Electric Corp., Buffalo, N. Y.
North Carolina	4	Mar. 21, '29	99	J. J. Strickland	G. H. Bennett	Durham Public Service Co., Durham, N. C.
North Texas	7	May 18, '28	164	H. G. Mathewson	E. H. Flath	Southern Methodist University, Dallas, Tex.
Oklahoma City	7	Feb. 16, '22	90	R. W. Linney	C. L. Jobe	Oklahoma Gas & Electric Co., Oklahoma City 2, Okla.
Philadelphia	2	Feb. 18, '03	863	H. E. Strang	M. L. Lehman	American Tel. & Tel. Co., 530 Bourse Bldg., Philadelphia 2, Pa.
Pittsburgh	2	Oct. 13, '02	657	G. W. Penney	R. C. Gorham	University of Pittsburgh, Pittsburgh, Pa.
Pittsfield	1	Mar. 25, '04	195	J. R. Meador	D. D. MacCarthy	General Electric Co., Pittsfield, Mass.
Portland	9	May 18, '09	177	A. O. Mangold	W. E. Enns	Portland General Elec. Co., Portland, Oreg.
Providence	1	Mar. 12, '20	93	H. P. Turner	G. E. Andrews	40 Bridgham St., Providence, R. I.
Rochester	1	Oct. 9, '14	121	Walter Criley	O. L. Angevine, Jr.	Stromberg-Carlson Co., 100 Carlson Rd., Rochester, 3, N. Y.
St. Louis	7	Jan. 14, '03	295	F. A. Cooper	F. J. McCluskey	James R. Kearney Corp., 4236 Clayton Ave., St. Louis, Mo.
San Diego	8	Jan. 18, '39	56	W. T. Johnson	J. W. Doolittle	Southern California Tel. Co., 914 C St., San Diego 1, Calif.
San Francisco	8	Dec. 23, '04	601	C. E. Baugh	D. I. Anzini	General Electric Co., 804 Russ Bldg., San Francisco 4, Calif.
Schenectady	1	Jan. 26, '03	630	O. C. Rutledge	P. H. Light	General Electric Co., Schenectady, N. Y.
Seattle	9	Jan. 19, '04	249	H. V. Strandberg	G. W. DeSellem	Westinghouse Elec. &Mfg. Co., 3451 E. Marginal Way, Seattle 4, Wash.
Sharon	2	Dec. 11, '25	162	H. S. Gates	F. D. Fielder	1324 Yahres Road, Sharon, Pa.
South Bend	5	Feb. 26, '41	48	L. F. Stauder	C. M. Dunn	General Electric Co., 112 W. Jefferson, South Bend, Ind.
South Carolina	4	Mar. 2, '40	55	F. W. Chapman	W. H. Kendrick	So. Carolina Electric & Gas Co., Columbia, S. C.
South Texas	7	May 23, '30	50	G. E. Schmitt	S. R. Friedsam	Lower Colorado River Authority, Austin, Tex.
Spokane	9	Feb. 14, '13	85	H. E. Mellrud	J. F. Gogins	General Electric Co., 421 W. Riverside Ave., Spokane 8, Wash.
Springfield	1	June 29, '22	51	A. L. Davis	B. N. Durfee	28 Talcott Ave., West Springfield, Mass.
Syracuse	1	Aug. 12, '20	129	M. H. Pratt	J. W. Dice	Westinghouse Elec. & Mfg. Co., 420 N. Geddes St., Syracuse 4, N. Y.
Toledo	2	June 3, '07	88	E. B. Thurston	W. M. Campbell	2145 Central Grove Ave., Toledo, Ohio
Toronto	10	Sept. 30, '03	381	F. C. Barnes	T. C. D. Churchill	76 Adelaide St., West, Toronto, Ont., Can.
Tulsa	7	Oct. 1, '37	79	W. E. Slemmer	P. E. Gentry	Southwestern Bell Tel. Co., 424 So. Detroit Ave., Tulsa 3, Okla.
Urbana	5	Nov. 25, '02	77	G. R. Peirce	A. D. Bailey	University of Illinois, Urbana, Ill.
Utah	9	Mar. 9, '17	85	T. A. Robinson	J. A. McDonald	General Electric Co., P.O. Box 779, Salt Lake City, Utah
Vancouver	10	Aug. 22, '11	98	T. Ingledow	L. B. Stacey	570 Dunsmuir St., Vancouver, B. C., Can.
Virginia	4	May 19, '22	147	C. E. Creecy	A. F. Forbes	Newport News Shipbuilding & Drydock Co., Newport News, Va.
Washington	2	Apr. 9, '03	675	A. G. Ennis	W. F. Dietz	Westinghouse Elec. &Mfg. Co., 323Washington Bldg.,Washington 5, D.C.
West Virginia	2	Apr. 9, '40	38	A. M. Rosenblatt	P. M. Barlow	Ravens Park, St. Albans, W. Va.
Wichita	7	Sept. 16, '37	62	G. W. Fisher	R. F. Dice	Kansas Gas & Elec. Co., 200 N. Market St., Wichita 1, Kans.
Worcester	1	Feb. 18, '20	57	J. H. Jewell	R. M. Peirce	American Steel & Wire Co., Electrical Cable Works, Worcester, Mass.
Total Sections						

Total Sections 74

OF CURRENT INTEREST

Report of Planning Commission Proposes Revisions in United States Patent Laws

Several specific means of improving our patent system are proposed in the first report of the National Patent Planning Commission, presented recently to President Roosevelt after an 18-month investigation of the mechanics of the patent law and the use of patents. The commission was appointed in December 1941, directly after the attack on Pearl Harbor, because the President believed that a study needed to "be made of our existing patent laws and procedure . . . by a commission familiar with the problems of science, industry, agriculture, labor, and the consumer." The members of the commission are: Charles F. Kettering, chairman; Chester C. Davis, Francis P. Gaines, Edward F. McGrady, and Owen D. Young; Andrey A. Potter, executive director; Conway P. Coe, executive secretary.

Specific recommendations made in the report are as follows:

1. Protection of the public interest

A. Compulsory recording of contracts.

B. In a suit for infringement, the limiting of a patent owner to a reasonable compensation without prohibiting use of the patented invention when its manufacture is necessary to national defense or public health or safety.

C. Provision for revocation of improperly granted patent.

2. Public register of patents available for licensing.

3. Uniform standard of invention.

A. Establishment of a uniform yardstick for patentability.

B. Re-examination by Patent Office of validity questions.

C. Creation of a court of patent appeals.

4. Establishing definite term of patent grant.

5. Simplification of appellate procedure.

A condensation of the report follows.

. . . The American patent system established by the Constitution giving Congress the "power to promote the progress of science and useful arts," is over 150 years old. . . . The strongest industrial nations have the most effective patent systems, and after a careful study, the commission has reached the conclusion that the American system is the best in the world. However, as with any system of long standing, conditions arise which were not foreseen at the time of its establishment. The American patent system should be adjusted to meet existing conditions without destroying its basic principles.

The basic principles enumerated in the report are that the system has

1. Encouraged and rewarded inventiveness and creativeness, producing new products and processes which have placed the United States far ahead of other countries in scientific and technological endeavor.

2. Stimulated American inventors to originate a major portion of the important industrial and basic inventions of the past 150 years.

3. Facilitated the rapid development and general application of new discoveries in the United States to an extent exceeding that of any other country.

4. Contributed to the achievement of the highest standard of living that any nation has ever enjoyed.

5. Stimulated creation and development of products and processes necessary to arm the Nation and to wage successful war.

6. Contributed to the improvement of the public health and the public safety.

7. Operated to protect the individual and small business concerns during the formulative period of a new enterprise.

PATENTS AND THE WAR EFFORT

Existing laws permit the Government of the United States and its contractors and subcontractors to manufacture and use any invention, patented or unpatented, regardless of the citizenship of the owner, upon the payment of reasonable compensation . . . After consulting with the several Government departments, including the War and the Navy, and affording them an opportunity for the presentation of evidence, the Commission is convinced that the existing laws are adequate to protect the Government during the present national crises.

PROTECTION OF THE PUBLIC INTEREST

The chief beneficiary of our patent system should be the American public . . . Despite these benefits to the general public . . . it is nevertheless true that patents may be and have been abused. The abuse arises not from the patent itself but by virtue of secret, improper, and even illegal agreements. . . . The Commission . . . feels that there should be a compulsory requirement for the recording of the agreements so that they will be available to the public, to governmental agencies, and to congressional committees.

The Commission therefore recommends the passage of legislation compelling the recording in the United States Patent Office of

1. All existing agreements to which one of the parties is a citizen of a country foreign to the United States.

2. All existing agreements, regardless of citizenship of the parties which include any restrictions as to price, quantity of production, geographical areas, or fields of use.

3. All future agreements, regardless of restrictions or citizenship of the parties.

After a study of the needs in this country and the effects in foreign countries of a compulsory licensing system, the Commission has reached the conclusion that it would not be advantageous to incorporate such a general system in our patent laws. However, the Commission is impressed with the need of a degree of compulsion in certain fields, such as national defense, public health, and public safety. . . . The Commission therefore recommends a statutory provision that in a suit for infringement the recovery of a patent owner shall be limited to reasonable compensation without prohibiting the use of the patented invention whenever the court finds that the particular use of the invention in controversy is necessary to the national defense or required by the public health or public safety.

There should be some provision whereby information and facts bearing upon the validity of a patent can be brought to the Patent Office, thereby giving it an opportunity to challenge the validity of any patent in a proceeding begun within six months after its grant. The enabling legislation should specify that the failure to challenge within the period indicated shall not prejudice the rights of any person in a subsequent infringement suit.

EXTENDING THE USE OF PATENTS

The Commission . . . recommends establishment in the Patent Office of a public register upon which would be placed those patents under which the owner would be willing to grant licenses on stated reasonable terms. When an interested party and the owner are unable to agree as to the unstated terms for a license under a patent entered on the register, the Commissioner of Patents shall fix the terms after an opportunity for hearing with right of appeal to the Court of Customs and Patent Appeals.

UNIFORM STANDARD OF INVENTION

The most serious weakness in the present patent system is the lack of a uniform test or standard for determining whether a particular contribution of an inventor merits the award of the patent grant. Revised Statute 4886 provides that a patent may be obtained by

> any person who has invented or discovered any new and useful art, machine, manufacture, or composition of matter, or any new and useful improvements thereof . . . upon payment of the fees required by law and other due proceedings had.

The difficulty in applying this statute arises out of the presence of the words "invented" and "discovered." Novelty alone is not sufficient, nor is utility, nor is the final accomplishment. There must also be present some mysterious ingredient connoted in the term "invented." . . . . There should be a uniformity in the grant and treatment of patents. The present confusion threatens the usefulness of the whole patent system and calls for an immediate and effective remedy.

. . . A promising improvement would be for Congress, by legislative enactment, to

lay down a reasonable, understandable test by which inventions shall be judged, both from the standpoint of the grant of the patent and the validity of the patent thereafter.

The Commission therefore recommends the enactment of a declaration of policy that patentability shall be determined objectively by the nature of the contribution to the advancement of the art, and not subjectively by the nature of the process by which the invention may have been accomplished.

. . . The validity of a patent is now passed upon initially by any one of almost a hundred district courts in the United States, by 11 different circuit courts of appeals, and occasionally by the Supreme Court. The test of invention should be the same and uniform, whether applied in the Patent Office or in any one of these courts . . .

. . . The Commission therefore recommends that, whenever the validity of a patent is attacked in an infringement suit before a district court, the court shall certify the record to the Patent Office for a report on the validity of the patent. The report of the Patent Office as to the effect of the court record upon the validity of the patent shall be advisory only.

As a final step in remedying the chaotic and confusing conditions surrounding the grant and validity of patents, the Commission considers it imperative to establish a single court of patent appeals which would receive and decide appeals from all of the district courts in patent cases, and whose decisions would be effective not only in a particular circuit but throughout the whole United States . . .

The creation of an entirely new court is not necessary. The Commission notes that the Court of Customs and Patent Appeals has now become a seasoned tribunal whose judges are trained and experienced in patent law. With expanded jurisdiction and additional judges, this court could function as a single patent court of appeals . . .

The Commission therefore recommends the establishment of a single court of patent appeals. It further recommends that the jurisdiction of the existing Court of Customs and Patent Appeals be expanded so as to function as such a court . . .

EARLY TERMINATION OF PATENT GRANT

The term of a United States patent is 17 years from the date of its grant. The expiration date of the patent is of special interest to the public, since it is then that the subject matter of the patent passes into the public domain. It is most desirable and in the public interest that the patent should be issued as promptly as possible after the application is filed. There are numerous ways in which the prosecution of an application can be deliberately delayed and kept pending in the Patent Office for an indefinite time—and the expiration of the term of the patent thus correspondingly deferred . . .

A proposal of long standing is that the patent monopoly shall not endure more than 20 years from the date of its filing in the Patent Office . . . A period of three years has been recognized as a reasonable period for prosecuting an application to allowance. There would be no change in the present 17-year period of a patent in those cases in which the prosecution did not consume more than three years. Any delays beyond that period, however, would ordinarily subtract from the duration of the patent . . . It is recognized that it would be unfair to penalize some applicants by the operation of such a law because a case encountered unavoidable delays or even delays for which the Patent Office was wholly responsible. Therefore there should be some provision for the restoration by the Commissioner of Patents of not more than two years to the life of a patent when the delay has been due to causes beyond the control of the applicant.

The Commission therefore recommends the enactment of a 20-year bill in substantially the same form as presented in H. R. 3211 to the 77th Congress.

SIMPLIFICATION OF APPELLATE PROCEDURE

When an application for patent is finally refused by the Patent Office, the inventor . . . has the option of either appealing to the Court of Customs and Patent Appeals, or filing a bill in equity for review in a United States district court . . .

The existence of these two parallel remedies is largely the result of historical accident and does not appear to be justified or required by any fundamental considerations . . .

The Commission recommends that in ex parte cases the jurisdiction of the Court of Customs and Patent Appeals to review the denial by the Patent Office of an application for patent should be made exclusive, and that the present concurrent jurisdiction of the district courts should be abolished. Sections 4911 and 4915 of the Revised Statutes should be amended accordingly.

SCOPE OF INVESTIGATION

The Commission has reviewed and considered various publications and compilations bearing upon the subject of its inquiry. Among these are

(*a*). The records of various congressional hearings.

(*b*). The reports of previous governmental commissions and investigating bodies.

(*c*). Reports, where available, of investigations made by or on behalf of industrial organizations.

(*d*). Numerous published papers and contemporaneous articles in trade journals, law journals, and popular periodicals.

Suggestions from individuals and organizations were submitted to the Commission in written communications and at conferences arranged by invitation of the Commission. Proposals and suggestions in great volume were received from widely scattered sources such as

(*a*). Representatives of Government departments.

(*b*). Manufacturers' associations, scientific and engineering societies, bar associations, and research institutes.

(*c*). Individuals, including lawyers, inventors, scientists, engineers, and manufacturers.

FUTURE REPORTS

The present report is confined generally to the mechanics of the patent law and the use of patents. The Commission is now engaged in a study of the policies involved in connection with inventions made by Government employees and by agents and contractors of the Government and with the control and use of patents owned by the Federal Government.

The Commission is also conducting a study in fulfillment of the final directive of the Executive order, i. e.

what methods and plans might be developed to promote inventions and discoveries which will increase commerce, provide employment, and fully utilize expanded defense industrial facilities during normal times.

The results of these studies will be the subject of future reports by the Commission.

Bureau of Standards Improves Standard Frequency Broadcast

The standard frequency broadcast service of the National Bureau of Standards radio station WWV, at Beltsville, Md., near Washington, D. C., has been improved and extended, a new transmitting station built, ten-kilowatt radio transmitters installed, and additional frequencies and voice announcements added, according to a recent announcement. The services include:

1. Standard radio frequencies.
2. Standard time intervals accurately synchronized with basic time signals.
3. Standard audio frequencies.
4. Standard musical pitch, 440 cycles per second, corresponding to A above middle C.

The standard frequency broadcast service makes widely available the national standard of frequency which is of value in scientific and other measurements requiring an accurate frequency. Any desired frequency may be measured in terms of any one of the standard frequencies, either audio or radio. This may be done by the aid of harmonics and beats, with one or more auxiliary oscillators.

The service is continuous at all times day and night. The standard radio frequencies are:

5 megacycles (= 5,000 kilocycles = 5,000,000 cycles) per second, broadcast continuously.

10 megacycles (= 10,000 kilocycles = 10,000,000 cycles) per second, broadcast continuously.

15 megacycles (= 15,000 kilocycles = 15,000,000 cycles) per second, broadcast continuously in the daytime only (that is, day at Washington, D. C.).

All the radio frequencies carry two audio frequencies at the same time, 440 cycles per second and 4,000 cycles per second; the former is the standard musical pitch, and the latter is a useful standard audio frequency. In addition there is a pulse every second, heard as a faint tick each second when one is listening to the broadcast. The pulses last 0.005 second; they may be

used for accurate time signals, and their one-second spacing provides an accurate time interval for purposes of physical measurements.

The audio frequencies are interrupted precisely on the hour and each five minutes thereafter; after an interval of precisely one minute they are resumed. This one-minute interval is provided in order to give the station announcement and to afford an interval for the checking of radio-frequency measurements free from the presence of audio frequencies. The announcement is the station call letters (WWV) in telegraphic code except at the hour and half-hour when the announcement is given by voice.

The accuracy of all the frequencies, radio and audio, as transmitted, is better than a part in 10,000,000. Transmission effects in the medium (Doppler effect, and so forth) may result in slight fluctuations in the audio frequencies as received at a particular place; the average frequency received, however, is as accurate as that transmitted. The time interval marked by the pulse every second is accurate to 0.00001 second. The one-minute, four-minute, and five-minute intervals, synchronized with the seconds pulses and marked by the beginning and ending of the periods when the audio frequencies are off, are accurate to a part in 10,000,000. The beginnings of the periods when the audio frequencies are off are so synchronized with the basic time service of the United States Naval Observatory that they mark accurately the hour and the successive five-minute periods.

Of the radio frequencies on the air at a given time, the lowest provides service to short distances and the highest to great distances. For example, during a winter day good service is given on 5 megacycles at distances from 0 to 1,000 miles, 10 megacycles from about 600 to 3,000 miles, and 15 megacycles from about 1,000 to 6,000 miles. Except for a certain period at night, within a few hundred miles of the station, reliable reception is possible, in general, at all times throughout the United States and the North Atlantic Ocean, and fair reception over most of the world.

Information on how to receive and utilize the service is given in the bureau's letter circular, "Methods of Using Standard Frequency Broadcasts by Radio," obtainable on request. The bureau welcomes reports of difficulties, methods of use, or special applications of the service. Correspondence should be addressed to National Bureau of Standards, Washington, D. C.

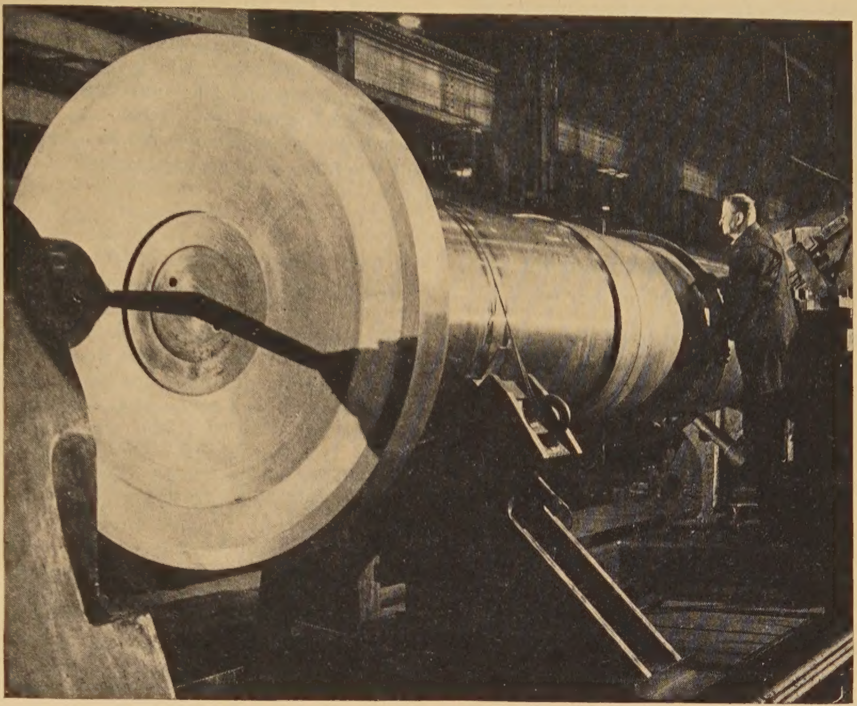
October 3–9 Designated Fire Prevention Week

Fire Prevention Week will be observed October 3–9, 1943, by proclamation of President Roosevelt and the governors of the 48 states. Fire losses are on the increase, and fires are reducing our war production almost $1,000,000 a day and destroying materials needed in the war effort.

During the year 1942 there occurred in the United States, Canada, and Alaska a total of 86 fires, each of which involved a loss of $250,000 or more—an increase of 38 fires over the number reported for 1941. Thirty of these fires caused individual losses of $500,000 or more, including seven which resulted in losses of $1,000,000 or more each. The largest fire loss of the year was the destruction of the liner Normandie in New York, N. Y., February 9, 1942. Depending on the success of salvage operations, the loss from this fire may reach $53,000,000. A total of 515 lives were lost in these fires, 492 of them being accounted for by the Coconut Grove night club fire of November 28. This is in contrast to a total of fifty lives lost in the corresponding fires of 1941.

During 1942 it is estimated that at least 10,000 lives have been lost as a result of fires. Farm fire losses took a toll of over $80,000,000 in property and 3,500 lives. One quarter of the 1941 fires were in manufacturing occupancies with a loss of $73,000,000. Such losses during wartime, when food and supplies are badly needed for us and our Allies and all our manpower and materials are required for a supreme war effort, should spur on all public and private organizations to unite in a campaign during Fire Prevention Week and throughout the year for the removal of all fire hazards which threaten our war production program.

Power "Spool" for Grand Coulee Generator



This 75-ton precision-finished solid steel "spool" being machined at Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., will transmit the force required to drive one of the generators capable of producing 108,000 kw at Grand Coulee Dam. The rotating part of the generator will be mounted on this four-foot-diameter shaft which will couple to a hydroturbine for converting the energy of the water to electric power. Four of the nine waterwheel generators ordered for this hydroelectric project already have been delivered

WAR PROGRAM • •

Construction Started on Motors for Stratosphere Wind Tunnel

Construction of two 20,000-horsepower electric motors for the United States Army's new stratosphere wind tunnel at Wright Field, Dayton, Ohio, has been started recently by Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa. The driving units are designed to propel a greater than 600-mile-an-hour gale of refrigerated air into the test chamber where model planes or scale models of aircraft parts will be suspended.

The new tunnel will be a rectangle of metal pipes 600 feet long and varying in diameter from 10 to 40 feet. It will supersede the two-year-old 400-mile-an-hour tunnel now in use and will enable the testing of the high-altitude performance of faster and more deadly fighting planes. The test chamber will duplicate the conditions encountered by pilots and planes in the lower stratosphere, maintaining a constant temperature of 67 degrees below zero and an air pressure less than one fifth as great as it is at sea level.

The two motors will be mounted at adjacent corners of the tunnel, and each will

be connected to its propeller by a 40-foot shaft piercing the tunnel wall. More than 4,000,000 cubic feet of air per minute will be driven through the tunnel by the two counter-rotating propellers mounted hub to hub in the 19-foot section of the pipes. The motors will have a top speed of 465 rpm and can be slowed down to 50 rpm, reducing the air velocity to that of a moderately stiff wind.

Industry to Be Canvassed for 15,000,000 Tons of Scrap

Estimates from the Business Press Industrial Scrap Committee indicate the need for 15,000,000 tons of iron and steel scrap during the coming six months for war production. Since private sources of scrap have been virtually exhausted, the bulk of this must come from industry.

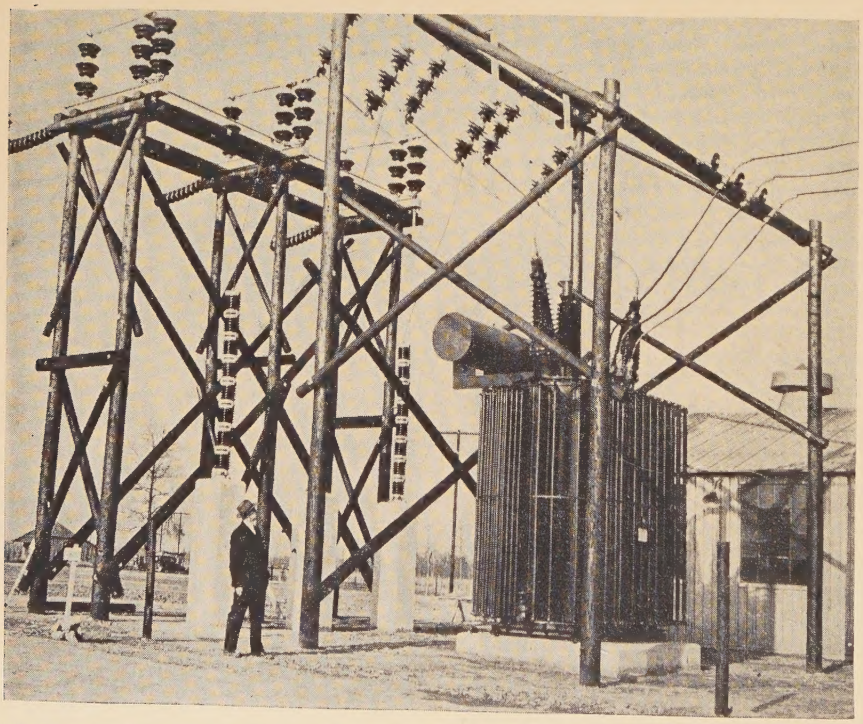
A total of 696 salesmen of steel mills, warehouses, and public utilities in the New York–Northern New Jersey region have volunteered to help the War Production Board ferret dormant scrap out of this region's industrial plants in a new intensified campaign to increase collections, according to Thomas W. Hoyt, regional salvage director. These men will discuss the scrap activities of individual plants throughout the region with presidents, plant managers, and salvage executives, reporting to the WPB on the scrap collection work in progress in each plant. When invited to do so, they will accompany salvage executives on a tour of each plant in an effort to identify additional items of dormant scrap.

Addition of more volunteers from public utilities and other industrial groups to the field corps is planned by the WPB as the program progresses, and it has been suggested that other sections of the country follow suit in a similar program.

Unused Copper Products Available for Civilian Manufacturers

Manufacturers desiring information about frozen or excess copper stocks can obtain lists of the quantities and kinds lying unused in the hands of the producers from regional offices of the War Production Board. If he has specific requirements, he should write directly to the Copper Recovery Corporation, 200 Madison Avenue, New York, N. Y. Printed forms may be obtained for submitting requests, but these are not necessary if the manufacturer will state his Controlled Materials Plan allotment number, together with the weight, description, size, and alloy of the copper products he desires. Use of material in the fabricated state would make unnecessary remelting of the stocks and would also minimize interference with the war-production schedules of mills making copper products to fill civilian needs.

Wood Substitutes for Steel on "Big Inch"



Wood substitutes for steel as superstructure for this outdoor substation at station 7 on the "Big Inch" pipeline in Arkansas. The power transformer shown is a three-phase 60-cycle 3,750-kva 110,000–2,400-volt General Electric unit

Emergency Physicists Needed

Several hundred persons from other fields who can do the work of physicists must be obtained as emergency substitutes in physical research and teaching, according to Homer L. Dodge, director of the Office of Scientific Personnel of the National Research Council.

Because of the heavy demands for research workers and teachers made upon this office in the field of physics, the supply of persons whose chief training has been in this field is exhausted. Although several hundred qualified persons are substituting already in such a capacity, reports of the National Roster of Scientific and Specialized Personnel indicate a need for several hundred more emergency physicists. All interested persons eligible to fill such positions, either in research or as teachers of beginning physics in the training programs of the armed forces, are asked to communicate immediately with Doctor Dodge, director of the Office of Scientific Personnel, National Research Council, 2121 Constitution Avenue, N. W., Washington 25, D. C.

Harbor Steam Plant Now in Service. The $9,000,000 Harbor Steam Plant of the Bureau of Power and Light of the City of Los Angeles, Calif., under construction since 1941 and recently placed in service, is an important factor in augmenting the city's power supply for war industries. The single 3,600-rpm unit now in operation is rated at 65,000 kw and weighs 466 tons; the rotating part of the equipment alone weighs 43 tons. Electricity is generated at 13,800 volts and converted to 132,000 volts in transformers located in the plant. Designed to operate either with oil or gas for fuel, the plant has an ultimate capacity of 300,000 kw. It is built to withstand an earthquake producing a horizontal force equal to ten per cent of the weight of the building plus 20 per cent of the weight of the equipment within.

New England Mica Mines Increase Production

Maine, New Hampshire, Massachusetts, and Connecticut mica mines have increased production of strategic mica according to recent reports from the mica and graphite division of the War Production Board. Although the New England mines produce only about two per cent of the United States total war consumption, the additional output does relieve somewhat the critical mica situation.

Minimum requirements of this material for immediate demands are about 20 per cent greater than the present world supply. The WPB is trying to stimulate the domestic production of mica not only to fill these requirements but also to create a more adequate stockpile. Need for mica is considered so insistent that 100 per cent increase would be desirable.

Shasta–Oroville Transmission Line Readied for 1944 Use

The Bureau of Reclamation has been ordered by Secretary of the Interior Harold L. Ickes to expedite construction of the Shasta–Oroville transmission line of the Central Valley Project in Northern California to insure an outlet for Shasta Dam power when 150,000 kw is available from the plant in March 1944.

The line, estimated at a cost of $1,900,000, will extend a distance of 98 miles from Shasta Dam down the Sacramento Valley to Oroville. The conductor will be made from 1,207,800 pounds of aluminum allotted by the War Production Board in lieu of copper. Work on the project is being accelerated at this time not only to increase power production but to aid war food output in the San Joaquin Valley through increased irrigation facilities. Hydroelectric power is needed urgently also to replace the output of oil-consuming steam-electric plants.

Radio Stations for Free French and Belgians. Two new 50,000-watt stations, supplied by the international department of the RCA Victor Division of Radio Corporation of America, are being installed on the west coast of Africa to broaden the coverage of the United Nations' radio network. The "Radiodiffusion Nationale Belge" at Leopoldville, in the heart of Belgian Congo, is already beaming daily broadcasts, primarily at Belgium, which report on the true progress of the war, and "The Voice of Free France," directed at France and all the French Colonial possessions, will soon be completed at Brazzaville in French Equatorial Africa. Both stations are equipped for RCA Radiophoto service. They are protected against tropical temperature and humidity by appropriate insulating and impregnation materials.

JOINT ACTIVITIES

Radio Technical Planning Board to Be Inaugurated September 15

Inauguration of a new Radio Technical Planning Board to plan postwar radio services and products will take place September 15 at a meeting of industry organizations concerned in New York, N. Y. Plans for the establishment of the organization have been completed by committees of the Institute of Radio Engineers and the Radio Manufacturers' Association and are being submitted to the other organizations.

The RTPB will be a technical advisory body to formulate recommendations to the Federal Communications Commission and other government and industry agencies on the technical future of radio developments. The RTPB will develop studies, investigations, recommendations, and standards as are required and submit them to the FCC and to other agencies having final authority.

The RTPB will be a representative democratic all-industry body. Initial sponsors, in addition to RMA and IRE, which will be represented at the September 15 meeting, are: AIEE, American Institute of Physics, American Radio Relay League, F. M. Broadcasters, Inc., National Association of Broadcasters, and National Independent Broadcasters. Other nonprofit radio, communications, and aeronautical groups may be included later.

Chairmen of the two committees are A. S. Wells, Chicago, Ill., for RMA and Haraden Pratt (F'37) for IRE. Other members of the committees are:

RMA: H. C. Bonfig, Camden, N. J.; W. R. G. Baker (M '41), Bridgeport, Conn.; R. C. Cosgrove, Cincinnatti, Ohio; Walter Evans, Baltimore, Md.; and Fred D. Williams, Philadelphia, Pa.

IRE: Alfred N. Goldsmith (F '20), New York, N. Y.; B. J. Thompson, Princeton, N. J.; and H. M. Turner (M '20), New Haven, Conn.

Criticism of Prime-Mover Speed Governor Specification Requested

Comments and suggestions on A Recommended Specification for Prime-Mover Speed Governing, prepared by a joint committee of AIEE and American Society of Mechanical Engineers, now available in preliminary form, are requested by the joint committee. The specification was presented at the AIEE national technical meeting, June 21–25, 1943, in Cleveland, Ohio, as a conference paper.

The present specification covers the speed governing of steam turbine generators rated at not less than 10,000 kw. The joint committee has intentionally limited the contents of the proposed recommended specification to those functional and performance characteristics that are generally believed to be the minimum requirements for satisfactory and acceptable speed governing.

The committee desires to obtain the reaction of the profession at large to this recommended specification for use as a basis for revision in advance of presentation to the AIEE board of directors and to the ASME council for approval and adoption, and as a guide for the amplification of the proposed recommended specification to include other types of prime movers. Critical examination and constructive criticism of this specification are therefore invited. An opportunity for further discussion will be afforded during the ASME annual meeting, November 29–December 3, 1943, at the panel discussion of this specification which AIEE members are invited to attend and participate in.

Copies of the proposed recommended specification are available on request from M. J. Steinberg (M '32), chairman of the joint committee on prime-mover speed governing, care of Consolidated Edison Company of New York, Inc., 4 Irving Place, New York, N. Y., and comments and suggestions about the specification should be sent to Mr. Steinberg.

Future Meetings of Other Societies

American Chemical Society. September 6–10, 1943, Minneapolis, Minn.

American Institute of Mining and Metallurgical Engineers. Electric furnace steel committee iron and steel division, October 1–2, 1943, Pittsburgh, Pa. Joint fuels conference, October 28–29, 1943, Pittsburgh, Pa. Annual meeting, February 20–24, 1944, New York, N. Y.

American Society for Metals. Annual convention, October 18–22, 1943, Chicago, Ill.

American Society of Mechanical Engineers. Annual Meeting, November 29–December 3, 1943, New York, N. Y.

American Welding Society. 24th annual meeting, week of October 18 1943, Chicago, Ill.

Association of Iron and Steel Engineers. Annual meeting, September 28–30, 1943, Pittsburgh, Pa.

National Electrical Manufacturers Association. October 25–29, 1943, New York, N Y.

National Safety Congress and Exposition, October 5–7, 1943, Chicago, Ill.

LETTERS TO THE EDITOR

INSTITUTE members and subscribers are invited to contribute to these columns expressions of opinion dealing with published articles, technical papers, or other subjects of general professional interest. While endeavoring to publish as many letters as possible, Electrical Engineering reserves the right to publish them in whole or in part or to reject them entirely. Statements in letters are expressly understood to be made by the writers. Publication here in no wise constitutes endorsement or recognition by the AIEE. All letters submitted for publication should be typewritten, double-spaced, not carbon copies. Any illustrations should be submitted in duplicate, one copy an inked drawing without lettering, the other lettered. Captions should be supplied for all illustrations.

24-Hour Time Designation

To the Editor:

In these feverish days of more and more rapid communication of all kinds, it has occurred to many that the designation of the time of day on the basis of two 12-hour cycles, with the necessity of specifying in each case a qualification that the hour is *ante* or *post* meridian, is quite obsolete.

Our European cousins for a long time have based their activities to a considerable extent on a 24-hour designation, with much resultant simplification in railroad timetables and consequent reduction of errors on the part of the public in meeting trains. The idea has not been generally accepted in this country, perhaps because of the same kind of conservatism which has inhibited adoption of the metric system

of weights and measures and the retention of feet, pounds, quarts, and degrees Fahrenheit.

Our Army and Navy have recognized the advantage of the 24-hour designation, and many thousand men and women in the Armed Forces are now familiar with the idea and base their daily routine upon it. It would seem to be an appropriate time to consider its adoption in our civilian life.

As a start, it is suggested that radio announcers who have occasion to mention the hour after noon be urged to give it on the present basis, followed by the 24-hour time. It seems to me the idea would quickly catch popular imagination, and it would be but a short step to general adoption, with its many advantages. Some individuals might desire double figures on their clocks and watches, but that would be a minor detail, and once the change is made, no further effort would be necessary.

SIDNEY WITHINGTON (F '24)

(Electrical engineer, New York, New Haven and Hartford Railroad Company, New Haven, Conn.)

Comparison of the Transform and Classical Methods

To the Editor:

In his article in the May 1943 issue of *Electrical Engineering*, Lyon presents a valuable interpretation of the problem of solving transients in electrical networks in the general case when the currents have initial values and there are initial charges on the condensers.

Of particular importance is the transformation on page 200 from the numerator of equation 6 which is a function of several of the roots to the numerator of equation 8 which is a function in the form of a polynomial of the one root p_1. If $f(p)$ is the characteristic polynomial, the denominator also may be transformed into a polynomial by means of the relationship

$$(L_1L_2-M^2)(p_1-p_2)(p_1-p_3)(p_1-p_4)=f'(p_1)$$

where $L_1L_2-M^2$ is the leading coefficient of the characteristic polynomial. If numerator and denominator of modified equation 8 at the top of page 203 are multiplied by $L_1L_2-M^2$, and double subscripts are employed, I_1 may be expressed as

$$I_{11}=\frac{\psi_1(p_1)}{p_1f'(p_1)}$$

This is identical in form with the coefficients of the partial-fraction expansion theorem. If all conditions are the same in the circuit of Figure 2 for modified equation 8 and for the operational equation for I_1 for Figure 2 on page 202, then the numerator of the operational equation for I_1 is $p_1\psi_1(p_1)$. It should be possible to prove this by algebraic manipulation. Hence, it should be possible to derive the operational solution in the partial-fraction form by the classical method. I have verified this in the case of the coupled circuit of Figure 2 for a d-c applied voltage and a stage of initial quiescence.

The coefficients in the primary and secondary currents of the coupled circuit of Figure 2 may be expressed as

$$I_{1m}=\frac{\psi_1(p_m)}{p_mf'(p_m)} \text{ and } I_{2m}=\frac{\psi_2(p_m)}{p_mf'(p_m)},$$
$$\text{where } m=1, 2, 3, \text{ and } 4$$

When the roots p_1, p_2, p_3, and p_4 of the characteristic equation $f(p)=0$ have been determined, the polynomials $f'(p)$, $\psi_1(p)$ and $\psi_2(p)$ may be evaluated for each root by synthetic methods such as synthetic division by a linear divisor or synthetic division by a quadratic divisor. The latter is treated on page 78 of *Advanced Practical Mathematics* by W. L. Cowley (Pitman, 1934)

Probably the most difficult part of the solution of an electrical network is the determination of the roots of the characteristic equation, particularly in the case where there are two or more pairs of complex roots. A method of locating complex roots which is as effective as any is to plot the contours $u=0$ and $v=0$ in the z plane for the purpose of determining their points of intersection. In his inaugural dissertation of 1799, Gauss made use of the asymptotic properties of these contours as the basis of his first proof of the fundamental theorem of algebra. The asymptotic properties of these contours have since received particular attention in numerous references. So far as I have been able to determine, the possibility of employing synthetic division to evaluate points on these contours has been overlooked completely. The procedure, which is easy to carry out, consists of transforming the polynomial by repeated synthetic division so as to subtract from the argument either a real numerical value or a pure imaginary numerical value. In the latter case, the synthetic division requires operations with complex numbers. This is not, however, a serious disadvantage, since the calculations can be carried out in two parts, one for the real and the other for the imaginary part. When the polynomial has been transformed either to subtract a real value or a pure imaginary value from the argument, the resulting polynomial may be separated into real and imaginary parts from which u and v may be obtained as auxiliary polynomials. The real roots of the auxiliary equation $u=0$ now determine points on the contour $u=0$ and the real roots of the auxiliary equation $v=0$ points on the contour $v=0$. When the complex roots have been located as intersection points of the contours $u=0$ and $v=0$, the calculation of more accurate values may be carried out by a method of successive approximations such as Newton's method. In connection with Newton's method, the numerical values of the polynomial and its first derivative are required for a value of the argument which approximates a complex root. The polynomial and its first derivative may be evaluated separately by available methods such as the quadratic-divisor method, or they may be evaluated by a two-stage method, for instance, the effective but slight extension of Bairstow's two-stage quadratic-divisor method given by Collatz on pages 235 and 236 of *Zeitschrift für Angewandte Mathematik und Mechanik*, volume 20, 1940.

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NEW BOOKS • • •

The following new books are among those recently received from the publishers. Books designated ESL are available at the Engineering Societies Library; these and thousands of other technical books may be borrowed from the library by mail by AIEE members. The Institute assumes no responsibility for statements made in the following summaries, information for which is taken from the prefaces of the books. All inquiries relating to the purchase of any book reviewed in these columns should be addressed to the publisher of the book in question.

Air Transport Navigation. By P. H. Redpath and J. M. Coburn. Pitman Publishing Corporation, New York, N. Y., and Chicago, Ill., 1943. 612 pages, illustrations, etc., 9 1/2 by 6 inches, cloth, \$5. (ESL.)

The basic information contained in this comprehensive work is useful to the private pilot as well as to the transport pilot and navigator for whom it is intended primarily. Fundamental theories are explained, necessary instruments are described, and practical procedures for establishing and flying a course by the various methods available are discussed. The combination of dead reckoning and radio direction finding is of particular interest. Routine navigation practice, including sample log sheets, and air line flight dispatching are also covered. A wealth of ready-reference information is provided.

Electrical and Radio Dictionary. Prepared by C. H. Dunlap and E. R. Hahn. Revised edition. American Technical Society, Chicago, Ill., 1943. 110 pages, diagrams, etc., 8 1/2 by 5 1/2 inches, cloth, \$1. (ESL.)

The main dictionary section of this book is separated into two parts, one for electrical terms and one for radio terms. In addition to these there are a brief glossary of electronic terms, a list of electrical symbols with pictorial explanations, and several pages of useful reference data.

PAMPHLETS • • •

The following recently issued pamphlets may be of interest to readers of "Electrical Engineering." All inquiries should be addressed to the issuers.

Pension and Profit-Sharing Plans. Research Institute of America, 292 Madison Ave., New York, N. Y., 1943. 48 pages, \$2.00.

Plan Now for Future Public Works. Construction and Civic Development Department, Chamber of Commerce of the United States, Washington, D. C., 1943. 18 pages, no charge.